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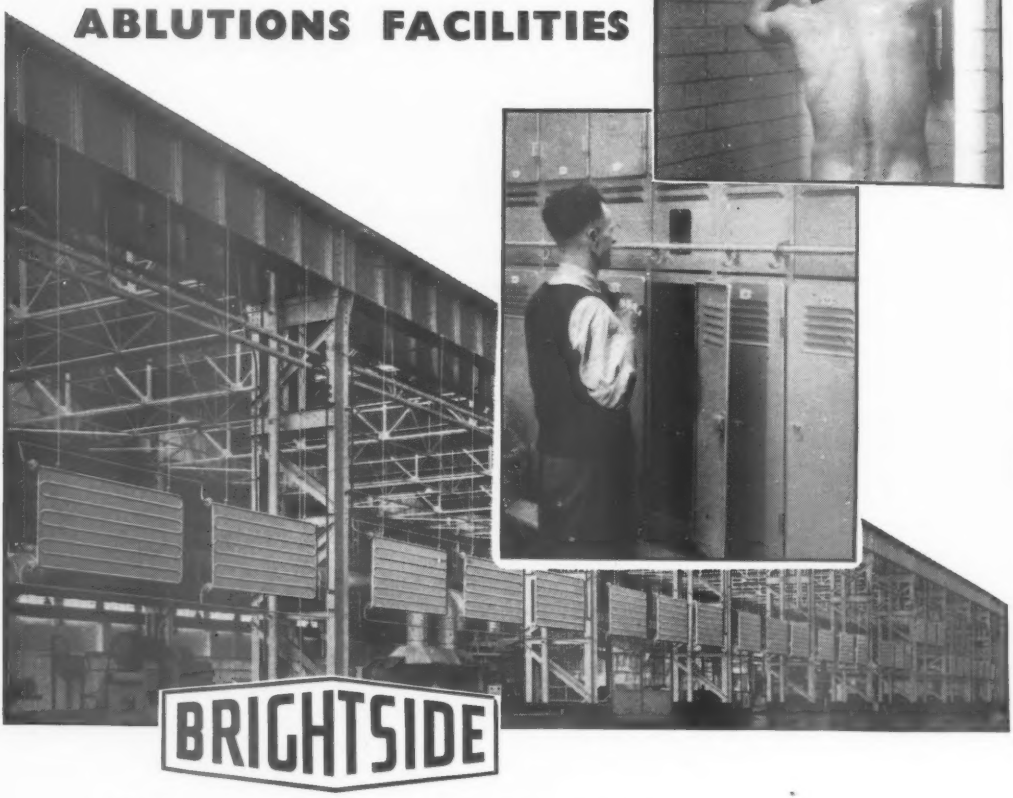

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*Editor:*
V. C. FAULKNER, F.R.S.A., HON.M.I.B.F.

*Assistant Editor:* A. R. PARKES, M.I.B.F.
*Commercial Editor:* P. E. CARDEN.
*Advertising Manager:* LENNOX HOLT, M.I.B.F.
*Production Manager:* R. J. LOVELL.
*Publisher:* H. J. DWYER.
*Circulation Manager:* E. T. GRIFFITHS.
*District Representatives:*
G. P. ELLIOTT (*Northern Area*)
T. H. SMITH (*Scotland*)

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# Post-Congress

The 22nd International Congress and the 52nd Annual Conference of the Institute of British Foundrymen will soon be just a memory. With the exception of the opening function, Mr. and Mrs. Hooper's garden party on the Sunday, which was marred but not entirely spoilt by rain, the rest of the week was favoured with excellent weather. The organization was severely tested, as no fewer than 1,250 people participated, but generally speaking, the arrangements were received everywhere with enthusiastic approbation. Obviously, in so vast a programme, there were hitches, but these were in two of the minor features. The major events, the receptions at Lancaster House and Fishmongers' Hall, the cabaret "Piccadilly Fare," the Congress banquet and the opening and closing ceremonies were splendidly carried through.

The technical sessions were both well attended and animated and the notion of either starting or finishing with technical films was much appreciated by those unable to follow discussions in a foreign language. This feature, we suggest, could well be followed in future international gatherings. Of course, there is also the possibility of holding an associated exhibition, which could fulfil much the same function. The foundry industry is greatly indebted not only to the ladies' committee but also to the wives of the officers both past and present of the Institute, who gave up so much of their time in guiding and generally looking after the guests. The linguistic abilities of Mrs. Mochrie did much to oil the wheels of the organization.

Dr. Everest, the newly-elected president, who has an onerous task in following Mr. John Bell, has done—and done exceedingly well—everything that his high office demands. He is a good, clear speaker and invariably says the right thing at the right time with dignity, salted with humour. He is to be followed in office by Mr. H. J. V. Williams, whose speech at the banquet made an excellent impression. Unruffled and imperturbable, Mr. George Lambert, the Institute's secretary, has carried through his first major task. His apprenticeship has obviously been well spent and he is now a master of his profession. Both the Institute and the International Committee are fortunate in having Mr. Lambert as their chief executive officer. Finally, we must congratulate Mr. Granström, who had the difficult task of carrying out his multitudinous duties in a language foreign to him. He has attracted to himself many friends and can be assured of a warm welcome whenever he revisits this country. There was a very large German delegation, headed by Mr. J. H. Küster, Dr. Schwietzke and Mr. P. Schneider. They were delighted with the reception accorded to them and are looking forward to receiving an equally large contingent from this country at next year's Congress in Düsseldorf.

## Lloyds' Open Day

Last Thursday, Lloyds (Burton), Limited, and Parker Foundry (1929), Limited (Derby), held an "Open Day" to mark the tenth anniversary of the opening of the former works, and to mark the formal opening of the new foundry at the Derby works. The Mayor of Derby (Councillor A. J. Luckett) and the Mayoress of Burton (Miss G. V. Clarke) officiated at the "Opening" ceremony. The programme of events included assembly at Lloyds (Burton), Limited, Wellington works, Burton-on-Trent, and luncheon, followed by a tour of the works. During this part, there was a demonstration of the manufacture of "Ductile Iron" by direct addition of magnesium in a pressure vessel, making high-duty cast iron by a duplex process—cupola melting and low-frequency induction re-heating—and an exhibition of engineering products embodying the firm's castings.

*Pressure ladle for making Ductile Iron by addition of metallic magnesium, at Lloyds (Burton), Limited.*

After tea, the party went by coaches and cars to Parker Foundry, Derby, for a tour of these works. Here they saw a new melting shop containing a 5-ton electric-arc furnace; a new foundry bay for medium-weight castings up to 8 tons (length 325 ft., width 60 ft.); a Speedslinger travelling the whole length of this bay; fully-mechanized sand-conditioning plant; new heat-treatment and automatic shotblasting plants, as well as an exhibition of products.

To complete the day's events, the party was entertained at dinner in the Midland Hotel, Derby. Brief particulars of both these works were recorded recently in the JOURNAL, as both were included in the itinerary of tour No. 1 of the International Foundry Congress.

## *Conference Paper Author*

Mr. A. Cibula, who is the Author of the Paper the "Influence of Grain Size of Bronzes and Gunmetals," printed on page 713 of this issue, is an investigator at the laboratories of the British Non-Ferrous Metals Research Association in London. He studied at Cambridge University from 1940-42 and 1946-47, where he obtained a first class Natural Science Tripos, Part II, Metallurgy, and his M.A. degree in 1947. From 1942 to 1946 he was assistant to the works metallurgist at Standard Telephones & Cables, Limited, North Woolwich, London. It was in 1947 that he joined the BNFMRA staff.

## Smethwick Scheme for Industry

Smethwick education authority, with the co-operation of local manufacturers, has prepared a scheme which, it is hoped, will curb the tendency of university graduates to seek jobs in commerce and attract more as factory executives. The proposal is for Smethwick boys, about to enter university, to spend a week in a factory during the school holidays. They will do no work and receive no pay, but they will be shown industry in action from work bench to sales room. Firms in the town hope to embark on the scheme this summer. Sixth formers leaving Holly Lodge Grammar School and James Watt Technical School for university will be invited to take part, and the West Bromwich, Smethwick and District Manufacturers' Association is drawing up a list of firms willing to participate; it includes iron foundries, machine tool and engineering firms.

"The idea is an extension of the schools' works visits," said Mr. H. L. Fellows, secretary of the Association. "If the boys can have a preview of industrial life they may well choose it as a career and take appropriate subjects at the university. There will be no attempt to persuade them in any direction, but the visits should stimulate their interest in industry." At least one Smethwick firm has been co-operating in a similar scheme for boys from public schools.

## Cast Bolts for Pipe Joints

To produce cast bolts for mechanical joints in pipe, a rather novel process is used by American Cast Iron Pipe Company. White-iron bolts are continuously cast in metal moulds mounted on turntables and malleablized by annealing. The unique feature of the process, described by C. K. Donoho in *Metal Progress* for May, is that, because of the quick freezing in the metal moulds, the silicon content of the iron can be as high as 3 per cent., while the bolts can be annealed in about one-tenth the time required for conventional sand-cast malleable material. The annealed bolts are said to have good machinability for threading, tensile strength of about 27 tons per sq. in. with adequate toughness, and corrosion resistance at least comparable to that of the cast-iron pipe with which they are used.

## Latest Foundry Statistics

The weekly average production of steel castings during March was 5,300 tons which shows no change over February. Of this quantity 1,200 tons was of alloy steel. Employment in this section of the industry on April 9 was 19,801. It was 183 more than on March 5.

# Twenty-second International Foundry Congress

## *Opening Ceremony*

The International Foundry Congress was opened officially on Tuesday morning of last week at the Dorchester Hotel by the Rt. Worshipful the Mayor of the City of Westminster. First, however, DR. A. B. EVEREST, the president, offered a welcome to the overseas delegates and their ladies, on behalf of the Institute of British Foundrymen, to London and to the twenty-second International Foundry Congress, with which was incorporated the fifty-second annual conference of the Institute.

It was very pleasing, he said, that there was such very large support for the Congress, and founders in this country were very glad to see so many old friends once more. From the figures, it looked as though the attendance at the Congress would be a record, because there were about 1,000 registrations of those participating, and with the guests the total numbers would be between 1,200 and 1,300. Of the official representatives there were 400 from abroad, representing 25 countries, and of course there was a very large complement from the Institute.

Offering a warm welcome to members of the Institute who had come from the other end of the world, he said there were branches in Australia and South Africa, and affiliations with institutions and associations of foundrymen in other parts of the Commonwealth. Particularly, he welcomed a member of Council of the Australian (Victorian) branch of the Institute, Mr. Jurss, and assured him that members in this country were very glad indeed that he had seen fit to travel half way round the world to be present at the Congress. Also, it was very pleasing to meet the representatives from other Commonwealth countries—Canada, India and Nigeria.

However, the Congress was international, and perhaps pride of place was to be given to colleagues from the Continent and from other overseas countries of the world. Dr. Everest said he was very glad indeed to welcome their spokesman, the president of the International Committee, Mr. Granström (from Sweden), who was supported by the vice-president of the International Committee of Foundry Technical Associations, Mr. Vuilleumier, from Switzerland. There were some 15 countries officially represented on the International Committee, which was the organizing committee for the International Congresses. Of these, Dr. Everest mentioned two, namely, Finland and Japan, since the occasion was the first on which members from these countries had joined a Congress as official representatives on the Committee. Other countries whose representatives were on the Committee and were attending the Congress were Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, the United States and, of course, Great Britain. He was very glad to welcome a large delegation from Germany and said that all would look forward to seeing German friends next year in their own country.

The organizers of the Congress had done their best to work out a programme which would provide entertainment and instruction, and he hoped the delegates would find it a fitting successor to the excellent programmes which were arranged at the recent conferences in Florence, Paris, Brussels, Amsterdam, and also in Atlantic City.

Speaking of the programme for the technical sessions, he said that the number of papers to be presented was much fewer than usual. It was felt by the organizers that it was only fair to the authors of technical papers that the numbers should be restricted so that there was adequate time for their presentation and discussion. He was sorry if some foundrymen were disappointed that their papers were refused at the last minute, but a time limit had been fixed and the Congress committee had had to adhere to it.

Another feature, which Dr. Everest said he hoped delegates would appreciate, was that a very extensive programme of films had been laid on to illustrate foundry developments throughout the world. His colleague, Mr. Frank Hudson, had organized that part of the programme and had obtained films, although at great difficulty, due to the Customs and also to the recent strike, which had made the transport of things like films very difficult. However, he had assembled a suitable collection and some would be shown at each technical session.

Finally, Dr. Everest said he hoped the Congress would be a success, that it would find all the delegates and visitors enjoying fellowship and friendship with technical stimulus and happy relaxation; he hoped also that overseas visitors would see something of our beautiful countryside.

### International Co-operation

MR. Y. R. W. GRANSTROM (president, International Committee of Foundry Technical Associations), on behalf of the overseas visitors, thanked Dr. Everest for his welcome and for the hospitality extended to them. All were aware, he said, of the great value of international congresses. There were the papers, the works visits, the committee work and, not least, the possibilities of meeting old friends and of making new ones. The interest for international industrial co-operation obviously grew and grew and there were signs that " curtains " and other artificial hindrances were beginning to move. Was that not the way founders and nations should go in order to secure better understanding between the peoples—the way to peace?

With regard to foundries, much had been done through the international congresses and by the International Committee. Many problems had been discussed and solved and the work in the three sub-committees went forward steadily. Reports on that work would be given during the Congress. The

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problems being discussed, however, were purely technical; but there was one other side to which attention should also be paid, and that was the human factor. In many countries, the engineering works and many other industries had rationalized and mechanized and had made working conditions easier, to a large extent, but many foundries were far behind. In a number of foundries there were mechanized installations, but he did not think they were sufficient to catch up with other industries. Work in foundries was still too hard, too dirty and too hot. In some countries there was a lack of labour, and it became very difficult to recruit labour in foundries particularly. To eliminate such shortages, it was necessary to use all available resources for rationalization, such as time-studies, including method- and motion-studies, MTM, physiological investigations, and so on. He hoped that those matters would be taken up by the International Committee.

Many of the visitors remembered with pleasure the last Congress in London 16 years ago and the post-Congress tours afterwards. They had all looked forward with great expectation to the present Congress, expectations which it was quite certain would be fulfilled, judging from the rich, varying and well-balanced programme. He congratulated and thanked the organizing committee and the ladies and gentlemen who had themselves taken so much trouble to make the Congress so successful.

DR. EVEREST, after thanking Mr. Granström for his remarks, introduced the Rt. Worshipful Mayor of Westminster, who had honoured the delegates by consenting to open the Congress. His Worship, Councillor Patrick Stirling, was the first citizen of the City of Westminster. It might puzzle some foundrymen from abroad, and even some at home, to know that, whilst the meeting was being held in Greater London, it was also in the City of Westminster. One hoped that perhaps His Worship would explain the reason for that geographical demarcation.

However, he had other qualifications for being present on that occasion. The Congress was international and His Worship was international enough to have been born in Paris, on which the delegates would congratulate him; and although he was a barrister, engaged in the legal profession, he went to Wolverhampton, one of the leading foundry centres in this country, to find a wife. So that he was well fitted to open the International Foundry Congress.

### Mayor's Welcome

THE RT. WORSHIPFUL THE MAYOR OF WESTMINSTER said it afforded him very much pleasure indeed to welcome the delegates to Westminster for their twenty-second International Foundry Congress. He understood, from what the president had said, that no fewer than 15 nations were officially represented, in addition to representatives from the Commonwealth, and he congratulated those who were responsible for the organization and preparation on having done such a magnificent job.

It was a great privilege to be Mayor of the great City of Westminster, which was the heart of the centre of the Commonwealth and our country. In offering a particularly warm welcome to visitors from overseas, he said most people were aware that the Houses of Parliament and the Abbey were in Westminster, and that might be the extent of their knowledge of the City; but if they were shown a map they would at once see about a dozen familiar places, because Westminster was London; in the City of Westminster there were the seat of Government, the royal palaces, the centre of national culture and, of course, the world-famous shopping centre.

Congresses and conventions from all world-wide organizations found themselves in the City of Westminster at some time or other; every day and every week throughout the year Westminster was a meeting ground for those who had joined together with common aims and interests.

It would take too long to give a lecture on local government organization in London; but His Worship said that London was composed of 27 boroughs and two cities (the City of Westminster and the City of London), and those townships or boroughs or smaller conglomerations formed the administrative County of London. That larger administrative County was presided over by the London County Council. Relations between all of them were very cordial, and between the City of Westminster and the City of London they were particularly close.

Those who were interested in statistics would be able to judge the measure of the responsibilities of the Westminster City Council when he said that Westminster had a ratable value of £11,400,000, that the net product of a penny rate was £45,600, and that this year the rate income was expected to be £9,530,000. He gave those figures because so often visitors had some difficulty in understanding the extent of the responsibilities borne by administrative bodies in the centre of London, and such figures were often of interest. At the Westminster City Hall, the civic authorities were assumed to know all that was going on within the City boundary and they hoped, being good hosts, that that assumption was not far from the truth.

(facing page) *Pictures taken during the early events of the International Foundry Congress in London last week.*

(1) Dr. Everest, Mrs. Everest and Miss Everest at Mr. Hooper's Garden Party on the Sunday; Mr. and Mrs. Hooper are shown (left) welcoming guests in (2) and other groups at the Party, in happy mood despite dull weather, are shown in (3) and (4). Picture (5) shows Dr. Everest and the Mayor of Westminster at the Opening Ceremony on Tuesday and in (6) the Mayor is congratulating Mr. John Bailes on the award of the Meritorious Services medal. Informal groups are shown in Nos. 7 to 10, and 11 and 12 show Dr. and Mrs. Everest with guests at the Fishmongers' Hall Reception on Tuesday—in No. 11 Mr. and Mrs. Braidwood are being received and in No. 12 Mrs. J. J. Sheehan. Amongst other well known personalities included in the groups are: Mr. Crump (left) and Mr. Chavy (France) in No. 7; Dr. Pearce (right) and Mr. S. H. Russell in No. 8; Mr. Goffart (Belgium) (left) and Mr. Curv (France) (centre) in No. 9, and Mr. E. S. Renshaw (right) recipient of the Oliver Stubbs medal, in No. 10.

They had tried to learn something of their guests; he had read with interest the history of the Institute of British Foundrymen, particularly in connection with international co-operation, and as he saw it, the work of the International Committee of Foundry Technical Associations was of paramount importance at the present time, because the mutual exchange of ideas and the formation of friendships made more easy the gradual breakdown of national barriers and the development through commerce of a healthy political understanding.

Foundrymen throughout the world might take pride in the fact that in the English language the term "cast iron" had become synonymous with what was irrefutable. We talked about a cast-iron defence, a cast-iron alibi, meaning a defence which was unshakable and also unbreakable—or so we hoped! He hoped that the friendships which the delegates to the Congress would make in Westminster would be truly cast iron. He hoped all delegates would enjoy their stay in Westminster, both in and out of the conference hall, and that their deliberations would be highly successful.

### Greetings

DR. EVEREST felt it was appropriate that the first act of the Congress, now that it was opened, should be to send a telegram of greetings to the Queen and her Consort, who was an Honorary Member of the Institute of British Foundrymen. He therefore submitted the following telegram for approval:—

> "MEMBERS OF THE INSTITUTE OF BRITISH FOUNDRYMEN, assembled with foreign delegates at the Dorchester Hotel, London, for the twenty-second International Foundry Congress, send loyal and respectful greetings to Your Majesty and to the Institute's esteemed Honorary Member, His Royal Highness The Duke of Edinburgh."

Dealing with some of the greetings received from friends at home and abroad, he said that until a few weeks ago Mr. Brizon—who was president of the International Committee at the time of the Congress in Florence last year and a very hard-working and loyal member of that Committee—had had every intention of attending the Congress in London. Unfortunately, however, Mr. Brizon underwent an operation a few weeks ago; he had written a very charming letter expressing his disappointment and regret that he was unable to attend and conveying his greetings to the Congress and his best wishes to all.

A telegram had also been received, addressed to the retiring president, Mr. John Bell, as follows:—

> "Please give Arthur Everest sincere wishes for happy and helpful year as president, from his Australian friends, Bert MacFarlane, Joe Donnelly and Bill Wright." Dr. Everest said he was very pleased that some of the Institute's Australian friends were present at the Congress.

An elaborately prepared letter of greeting was received from the Japanese Association, whose representatives were welcome visitors to the Congress. It read:—

> "The Nippon Imono Kyokai extends its heartiest greetings to the International Foundry Congress and feels honoured to have been invited to participate.
>
> "We congratulate the British Foundrymen on their enterprise in organizing this Congress, to be held after an interval of 16 years. We feel certain that the Congress will not only result in the crystallization of information pertaining to foundry technical developments and engineering practices, but will also promote international goodwill.
>
> "We are fortunate in having one of our members, Dr. Koi Kawamura to extend in person those greetings.
>
> "With best wishes for a most successful meeting, we remain, faithfully yours." (It was signed in Japanese by the President.)

A letter from India read as follows:—

> "We are pleased to learn that the International Foundry Congress is to be held in London. Please accept our best wishes for the grand success of the above Congress."

Another letter was received from Mr. Joseph Léonard, of Belgium, who had planned to attend the Congress and regretted very much that he was unable to do so. The writer sent his very best greetings.

Dr. Everest asked the delegates of all the countries represented at the Congress to take back to their respective Associations the very best wishes of the whole of the assembled delegates.

MR. JOHN BELL (immediate past-president) then invited the Mayor of Westminster to present the medals and prizes awarded during his year of office. The recipients, who had been presented to the annual general meeting of the Institute on the previous day and then given the opportunity to make their acknowledgments, were in turn introduced to the Mayor, who personally congratulated them.

Expressing thanks to the Mayor, Mr. Bell said that the Institute of British Foundrymen and the International Committee of Foundry Technical Associations were highly honoured by his presence on that occasion. Not only, he said, was the City of Westminster very ancient and important, and its Mayor a very busy man, but it was known throughout the world as the home of the "mother" of Parliaments. There was history, dignity and tradition attached to Westminster of which all British people were proud, and for those attending the Congress that sense of pride had been increased by the kind and encouraging words used by His Worship. He had also presented the various awards in a most charming manner, which would make them doubly dear to their recipients.

HIS WORSHIP, in a brief acknowledgment of the vote of thanks, said how very much he had enjoyed the occasion and added, jocularly, that his wife and himself were looking forward to attending the Congress banquet on Friday evening.

(Accounts of other important events of Congress week will be printed in next week's issue of the JOURNAL).

# Institute of British Foundrymen

## *Annual General Meeting in London*

The fifty-second annual general meeting of the Institute of British Foundrymen was held in the Dorchester Hotel, London, W.1, on Monday, June 20, 1955, Mr. John Bell (the retiring president) in the chair. Apologies for absence were received from Mr. John Cameron (senr.), a past-president, who sent his good wishes to all his old friends, and from Mr. J. McPheat. On the motion of Mr. F. Arnold Wilson, seconded by Mr. J. K. Smithson, the minutes of the last annual general meeting held at Glasgow on June 23, 1954, were taken as read; they were confirmed.

### Annual Report

The PRESIDENT, presenting the Report* of the Council of the Institute for the session 1954-55, said it was comprehensive and covered very fully the work of the Council during that period.

Mentioning two things which made it different from any other reports for a long time, he said all were very glad that during the session the Council had been able to announce the acceptance by H.R.H. the Duke of Edinburgh of honorary membership of the Institute. That election, coming as it did some 24 years after the Institute's incorporation by Royal Charter, indicated that the work done since then by the Council and office-bearers had been found to be very satisfactory and worthy of further recognition in high places.

Second, the Report was the first for many years that had not been prepared by Mr. Tom Makemson, the late secretary. A year ago Mr. Longden, who was then president, had paid a graceful and well-merited tribute to all that Mr. Makemson had done, but one was reminded of the old loyalist cry "The King is dead; long live the King." The Council had appointed Mr. Lambert to succeed as secretary, and the Report now presented was the first he had prepared. Having had the good fortune to work very closely with Mr. Lambert, knowing what he had to do and how efficiently he had done it, Mr. Bell felt sure the Council and its committees and the Technical Council and its sub-committees, would agree that he had done a remarkably good job.

On the motion of the president, seconded by Mr. E. Longden, the Report was adopted.

### Accounts and Balance Sheet

MR. NOEL P. NEWMAN, J.P. (hon. treasurer) presented and proposed the adoption of the Balance Sheet as at December 31, 1954, and the statement of accounts for 1954. He said that both income and expenditure had increased, but there was a surplus for the year of £681.

DR. C. J. DADSWELL (past-president), seconding, said that, not being a member of the finance committee, he was able to examine the accounts with a critical eye, and it would be agreed that they represented a satisfactory state of affairs. He expressed appreciation of the work of the finance committee and thanked the hon. treasurer for the care and attention that he gave to the Institute's financial affairs. The accounts and Balance Sheet were then adopted.

### Technical Council's Report

MR. A. E. PEACE (chairman of the Technical Council), proposing the adoption of the Report of the Council,† said the work had covered a wide field of interest. Work on a number of items on the Council's programme had been completed and details were to be published, and the sub-committees expected to complete more of their investigations during the present year. It was particularly pleasing to have the comprehensive review of the work of the Joint Gases Committee which was being presented to the International Foundry Congress during that week, and also with what was regarded as a very important report on the shatter index of sand compacts, by the Joint Sands Committee, which had been published.

It was hoped the publication of the "Atlas of Microstructures," covering steel, non-ferrous and iron castings, would not be long delayed. This atlas would be a very valuable production and would be expensive to produce, but he believed members could be assured of the requisite financial backing, from his reading of the Institute's Balance Sheet.

The Technical Council had expressed appreciation of the help received from various sources, and he was glad that in the annual report there was a special reference to technical development, for which the Technical Council was essentially responsible. Mr. Peace was anxious to confirm the expression of appreciation by the Institute's secretary, in that section of the annual report, of the financial assistance given by the Joint Iron Council.

Again, it was not perhaps realized by members generally to what extent the members of the branches contributed to the work of the technical sub-committees. In the section of the annual report which dealt with branch activities, some most appropriate words were used concerning the contributions made to the work of the Technical Council. As stated there, the branch activities revealed a striking record of voluntary help which contributed in great measure to the cohesion and strength of the Institute. Mr. Peace, after intimating that, shortly, the Technical Council would set up a number of new sub-committees to deal with projects of varied and timely interest, moved the formal adoption of the Technical Council's report.

MR. G. R. SHOTTON seconded the resolution and, as a long-standing member of the Technical

* Printed in the JOURNAL, June 23, 1955.

† Printed on page 729 of this issue.

(1) *Mr. Granström makes the award of the Perseus statue and the smaller replica to Mr. V. C. Faulkner.*

(2) *The Congress president, Dr. A. B. Everest (centre) with the new IBF vice-presidents, Mr. H. J. V. Williams (left) and Mr. J. Blakiston.*

(3) *Table group at the Friday banquet (from left to right): Mrs. Blakiston, Mr. Spies, Mrs. Williams, Mr. Blakiston, Mr. Williams (front, centre), Mrs. Everest, Dr. Everest, Miss Everest, Mrs. Spies and Mr. Granström.*

(4) *Part of the Friday Banquet at the Dorchester Hotel, approximately 900 members and guests participated.*

Council, paid tribute to the energetic work of its chairman, Mr. Peace, and of its vice-chairman, Mr. McPheat.

THE PRESIDENT added an expression of the Institute's indebtedness to all the members of the Technical Council and those who assisted in the work, and said he had been greatly impressed not only by the quantity of the work done, but also by its quality.

The Technical Council's Report was adopted.

### Awards

This year, the awards* made during the year were not presented as was customary at the annual general meeting, the actual presentations being deferred until the official opening of the International Foundry Congress on the following morning. However, at the annual meeting, the president received and congratulated the recipients and gave them the opportunity to respond.

*The E. J. Fox Medal* was awarded to Dr. L. B. Pfeil, of the Mond Nickel Company, Limited, in recognition of his outstanding services to the foundry industry and metallurgy, and in particular for his work on high-temperature alloys.

DR. PFEIL confessed to very considerable embarrassment in acknowledging the award because, he said, he really did not feel that he had done work which deserved so high an honour. For some 25 years it had been his responsibility to try to set up conditions under which a team of technical men could do a good job of work. If some of the work with which he had been associated was of interest to the founding industry, he was certainly very happy. During many years, he had watched the progress of the foundry industry with great interest and had been greatly impressed, particularly by the steadily and rapidly rising standard of quality of castings. There were many ways in which that high quality had been demonstrated, but to his mind the specifications now current were proof of the improvements which had taken place. Another example was the extensive use of castings for critical components in aircraft; that was most outstanding and provided absolute proof of the quality of current materials.

The Institute of British Foundrymen could take much pride in the contribution it had made to those improvements in the industry. He was very happy indeed to have the honour of joining the band of recipients of the E. J. Fox Medal, which he looked upon as quite one of the outstanding things that had happened to him.

*The Oliver Stubbs Medal* was awarded to Mr. E. S. Renshaw, of the London branch of the Institute, in recognition of his outstanding contributions in the field of cupola practice and the readiness with which he has imparted his knowledge to his fellow members of the Institute and associated bodies abroad.

MR. RENSHAW said there were others who had contributed to the work for which the award was made, and he accepted it with humility. He belonged to an organization in which it was considered a mortal sin to be anything but progressive, and he was associated with a body of individuals without whose assistance the work would not have been forthcoming. Therefore, he considered the award not so much a personal one, but as an acknowledgment of the work of a group of people with whom he had the pleasure to be associated. He hoped the work would be continued.

*The Meritorious Services Medal* was awarded to Mr. John G. Bailes in recognition of his outstanding work on behalf of the Institute and the Sheffield branch, and in particular for the exacting duties he has carried out so efficiently as chairman of the Institute's membership committee.

MR. BAILES, after commenting that in following Mr. Bell he was indebted to one of the best possible tutors, said that a habit of his in life was to do a job when it was there, so that afterwards he could sit back and relax. He was still looking for the relaxation! In thanking the Institute sincerely for the award, he added that if any work of his or the membership committee were deemed worthy of the award of the medal, they would certainly try to earn a bigger one, for they had more work to do.

*British Foundry Medal and Prize.*—This was awarded to Mr. John M. Langham for the excellence of his Paper on the "Founding of Marine Propellers" which was adjudged by the Council to be the best paper in volume XLVII of the *Proceedings*. (The medal and prize were established by the FOUNDRY TRADE JOURNAL.)

MR. LANGHAM, expressing his appreciation of the honour, said he was most surprised and, of course, delighted to receive it. He himself regarded the award, and he hoped it would be regarded by those who worked with him in a rather specialized foundryman's craft, as being a tribute to work in which they all participated.

### "John Bell" Travelling Scholarship

THE PRESIDENT said that the John Bell Travelling Scholarship was an award which the Institute was making this year for the first time. It was being given to the student of metallurgy in the Royal Technical College, Glasgow, who in his final year achieved the highest marks, and the purpose of the award was to enable the recipient to undertake a tour of industrial and/or academic establishments in Britain or abroad. The recipient would also prepare a report on his tour, which would be available to the Institute for publication.

The award for 1954-55 was won by Mr. David M. Clinton, a native of Carluke, Lanarkshire, who is on the staff of Clyde Alloy Steel Company, Limited, one of the Colville Group. He had been an outstanding student; in his first year at the Royal Technical College he had gained a Governor's scholarship, a mathematics prize, the Blyth Memorial prize in natural philosophy, and the Dr. Stockdale prize in metallurgy. It was necessary for him to return to Glasgow on the following day, to sit for his degree examination. With the award, he proposed to travel, possibly to Germany,

* See page 727 of this issue.

*The president, Dr. A. B. Everest, and Mrs. Everest, with some of the chief guests at the Annual Banquet on Friday. The group includes Lord Kilmuir, the Lord Mayor of London, the Mayor of Westminster, the City Sheriffs, the International Committee president (Mr. Granström) and several of the ladies.*

after which he would carry out his National Service obligations and then most probably return to the Clyde Alloy Steel Company, Limited.

MR. CLINTON, acknowledging the award, said he was somewhat embarrassed to be present at so distinguished a conference. However, he was very happy and grateful to receive the first award of the John Bell Travelling Scholarship, especially at the time when Mr. Bell was president of the Institute. He thanked Mr. Bell, and Mr. Marshall, of the Scottish branch, and all who were responsible for the endowment and organization behind the scholarship. All he could offer them in return was an assurance that he would put the award to the best possible use.

### Diplomas

THE SECRETARY (Mr. G. Lambert) then announced that the Council had awarded diplomas of the Institute to the following for papers presented during the last session: Dr. B. H. C. Waters, for his Paper "Place of Shell Moulding in the Foundry," presented to the Sheffield branch; Mr. G. H. Hart, for "Aspects of Steelfoundry Practice," presented to the Scottish branch; and Mr. A. Talbot, for "Cores and Moulds by the $CO_2$ Process," read before the London branch of the Institute.

### Election of Officers, 1955-56

*President*

THE CHAIRMAN (Mr. Bell) proposed with very much pleasure the election of Dr. Arthur B. Everest as president of the Institute for the coming session. That pleasure, he said, had nothing to do with the fact that he would be laying down his burden and asking Dr. Everest to take it up. Rather did he feel somewhat like a runner in a relay race. He had run his course, and as he passed on the staff he had carried for a year he knew that, when Dr. Everest had run his lap, he would hand it to his successor better than when he had received it.

Dr. Everest was a man of many gifts. He had worked in the foundry, in the laboratory, and in the drawing office. He had been a keen student of metallurgy from an early age and had gained his Doctor's degree for some interesting research work quite early in his career. Not long after that, Mr. Bell had met him for the first time; that was 27 or 28 years ago, and throughout all those years he had been fully aware of the good work Dr. Everest had done and was doing for the Institute.

The nature of his work had led him to prepare and submit many papers of high technical value, and the fruits of his studies and research had been given freely to the Institute and to kindred associations at home and abroad. He was one of the Institute's members whose fame had reached far beyond the confines of our own country. The award to him of the Gold Medal of the French *Association* afforded proof of that. At home, he had had time to help in the work of the London branch, and eventually to become its president; he had also served on the Institute's Technical Council for more than 20 years, for many of them as its vice-chairman.

Abroad, Dr. Everest had taken a keen interest in the work of the International Committee of Foundry Technical Associations and its various subcommittees. Therefore, it would seem to be particularly appropriate that he should become president of the Institute at that hour, when the Institute was acting as host at the International Congress. One knew that he would bring to his presidency the same sense of duty that had characterized his earlier

years, the same ability and devoted hard work, and the same desire to find a satisfactory solution to every problem that arose. He would advance the prestige and efficiency of the Institute, and one had every confidence in proposing his election.

MR. V. C. FAULKNER (past-president) recalled that it was more than 25 years since he had first met Arthur Everest, and he had since followed with pride the great progress he had made. In the early 1920's, there was a quite unofficial meeting of an equally unofficial executive who, in their wisdom, had laid it down that presidents of the Institute should come from those people who had worked for the Institute and who at the same time had been prominent in the industry. It had always been stressed that presidents must have worked for the Institute, and the members could not have chosen anyone who had worked more assiduously and more enthusiastically than had Dr. Everest. It was a great pleasure to second the proposal that he be elected.

Dr. Everest, having been elected, amid applause, was invested with the presidential badge by Mr. Bell, who congratulated him on his election and the members on their choice.

DR. EVEREST, expressing his thanks for the very kind way in which his election had been proposed, seconded and accepted, said it was indeed a very proud moment for him. At the same time, he felt very humble; he had always regarded with a great deal of reverence those who had occupied the presidential Chair, and he had marvelled at their tact and enthusiasm and ability in furthering the aims of the Institute. After a tribute to Mr. Bell, he said it was pleasing that Mr. Faulkner had seconded his election, for they had first met in a hotel in Paris about 27 years ago, when they were on their way to the Fourth International Foundry Congress, held that year in Barcelona. From that day, Mr. Faulkner had taken him under his wing and had always acted as his sponsor, for which he was particularly grateful.

Amongst a large number of messages of good wishes for the International Congress and for his own year of presidency, Dr. Everest referred particularly to one from Mr. John Cameron. He recalled that soon after he began trying to spread the "gospel of metallurgy" his path had taken him to Scotland, where he and others had formed a working team and where Mr. Bell was very helpful. One very well known foundryman who had held out the hand of friendship and had been very good indeed to him in those early days was Mr. Cameron. Last year, in Glasgow, Mr. Cameron had said that nothing would prevent his coming to London to see him (Dr. Everest) invested with the presidential chain of office. It was with real sorrow that, three days previous, a letter was received from Mrs. Cameron stating that John—now 86 years old—had had a fall a little time ago and, whilst he was recovering, he had not the confidence to face the journey to London. All members would regret that fact; Dr. Everest acknowledged his good wishes, mentioning that Mr. Cameron was one of his early sponsors.

During the next twelve months, he continued, it was his intention to go forward and to do his very best for the Institute. In that, of course, he depended entirely on the support and help of all the membership. The Institute was growing in strength year by year, and he hoped that when he handed on the baton to his successor a year hence the Institute would be still stronger and still more vigorous.

He then presented to Mr. Bell a past-president's badge as souvenir of his year of office and asked him to continue to conduct the annual general meeting.

### Senior Vice-president

MR. J. W. GARDOM (past-president) recalled that in Glasgow last year he had proposed the election of Mr. John Williams as junior vice-president of the Institute. Having before then, and since, noted the methods he employed in dealing with matters which had to be considered, and knowing Mr. Williams' efficiency and his high moral standing, he was glad to be able on the present occasion to propose his election as senior vice-president.

MR. A. S. WALL, who seconded, said that as secretary of the Wales and Monmouth branch he, too, had kept his eye on Mr. Williams, who was a most assiduous worker for the Institute and for the branch. Also, he had a reputation to maintain, for his illustrious uncle, Mr. C. E. Williams, who was president in 1933, had set up a record which it would be hard to beat.

MR. WILLIAMS, having been elected and invested with the senior vice-president's badge, expressed his appreciation. He said he regarded himself as fortunate that he would be serving his apprenticeship under Dr. Everest. At this intermediate stage, he felt it proper to mention that it was hoped to hold the Institute's conference next year in Cardiff; and he was very pleased that many members had said they looked forward to visiting Cardiff again, after quite a number of years.

### Junior Vice-president

DR. C. J. DADSWELL (past-president) said he had great pleasure in proposing Mr. J. Blakiston's election as junior vice-president for at least two reasons. The first was a rather sentimental one, in that Mr. Blakiston was the nominee of the West Riding of Yorkshire branch of the Institute, which branch was host for the first annual conference at which he (Dr. Dadswell) had presented a paper, in 1938. The second reason for his pleasure was that he was confident that the Institute would be well served by Mr. Blakiston as junior vice-president, because of his wide experience and knowledge in both the technical and administrative spheres in the foundry industry. That knowledge and experience had been gained not only in this country, but also abroad; he was accepted at home and abroad as a most knowledgeable consultant in foundry engineering and was a very fitting nominee for the office of junior vice-president of the Institute for the coming year.

MR. G. W. NICHOLLS, seconding, said that from his associations with John Blakiston over the last

16 years he could vouch that he was a man of light and learning in the foundry trade and of the highest standard of integrity; he was as frank as a mirror and also believed that the way to gain a good reputation was to endeavour to be what he desired to appear. Again, he was one who appreciated that such a high honour meant a certain amount of personal sacrifice to himself, but Mr. Nicholls could guarantee that in handling the Institute's affairs he would go into things more searchingly than would any Customs inspector. The members of the West Riding branch were extremely proud of Mr. Blakiston, particularly on account of the excellence of his work for that branch and for the Institute at large.

There being no other nomination, Mr. Blakiston was duly elected and was invested with his badge of office by the chairman, who commented that Dr. Dadswell and Mr. Nicholls had not at all exaggerated in their remarks.

In thanking the meeting for having elected him to that junior, but important, office, MR. BLAKISTON said it had been filled during the last three years by a Scotsman, an Englishman and a Welshman, and now the Institute had fallen back on a Yorkshireman. He did not know what that signified, only time would tell, and he could only reiterate that he would strive to justify the confidence placed in him.

### Auditors

On the motion of Mr. J. K. Smithson, seconded by Mr. V. C. Faulkner, the meeting re-appointed J. & A. W. Sully & Company (chartered accountants) as auditors for the year 1955/56.

### Members of Council

THE SECRETARY announced that, as the result of the ballot for the election of five members of Council for the two years ending June, 1957, the following had been elected:—Mr. P. A. Russell; Mr. G. R. Shotton; Mr. V. Delport; Mr. F. Arnold Wilson, and Mr. C. Barrington Hooper.

### Thanks to Retiring President

DR. EVEREST, in proposing a hearty vote of thanks to Mr. Bell, the retiring president, said members would have read the record of his services in the Institute's *Journal* and also in the special issue of the FOUNDRY TRADE JOURNAL which had been distributed at the meeting. Mr. Bell had travelled 20,000 miles in the course of his presidential duties, he had eaten at a large number of banquets on the Institute's behalf and he had done everything a president was expected to do. In spite of his 72 years, he had put others to shame by his energy and agility in travelling around the country, attending meetings everywhere and appearing on all occasions when the president might or should appear. He had set a very high example of duty and care for the affairs of the Institute, and had not spared himself. Always the principle which had guided him as president was: What was best for the Institute. As a result, the Institute was bigger and better at the end of his term of office than at the beginning, and membership was a record, at about 5,500. Indeed, in every direction the Institute was growing.

All present would wish to pay tribute, not only to his wise leadership, but also to the courtesy and the friendliness with which he had graced the presidential Chair, and which had surrounded all his activities. It was therefore a very great pleasure to propose a very hearty vote of thanks to him for all that he had done.

MR. NOEL P. NEWMAN, J.P. (hon. treasurer), seconding, said it was very difficult to speak of any particular outstanding quality of John Bell because he had so many. Nevertheless, Mr. Newman mentioned one which he personally had experienced at a time he had needed it, and that was his great kindness; he had brought to his office charm, kindness and understanding. For the work he had done in attending every conceivable meeting and social function of the Institute, and for the quiet dignity and efficiency with which he had maintained its prestige, all were grateful.

(The vote of thanks was heartily accorded.)

MR. BELL, in expressing his appreciation, said he was glad to have had the opportunity to be president. Throughout his life, he had been guided by a very simple rule; he had never sought office, the spotlight had no attractions for him, but if at any time he had been asked to do anything that seemed reasonably within his powers he had never refused, but had just done his best. In this case he had done his best to be a good president.

He was not a man of many talents; he regarded himself as being essentially a one-talent man and, to be honest, he was not sure even at this late hour what his particular talent was. However, he was glad that his work as president was held to be successful. It had been for him a period of real enjoyment; his journeying (which now totalled nearly 23,000 miles), the banquetings, the speeches —even those he had made himself—the people he had met, the kindness he had received, the memories he had built up, had given him much happiness. It had given him very great pleasure also to realize the high esteem in which the Institue was held. At the beginning of his year of office he had said that he always tried to put more into the Institute than he could possibly take out, but that he had found that the more he put in, the more came back to him.

Thus he was indebted to all. It was he who should be expressing thanks, and he did so with all his heart, for a wonderful year in office.

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THE MAY MEETING of the Australian branch of the Institute of British Foundrymen took the form of a round table conference in the Union Dining Room, University of Melbourne. There were three speakers each introducing a separate subject. Mr. R. Whitelaw, of the Russell Manufacturing Company, dealt with metallurgy; Mr. A. Palmer, of McPhersons, Limited, covered moulding; and Mr. G. Eric Miller, of Allied Ironfounders, Limited, took for his subject, mechanization.

# Influence of Grain Size on Structure, Pressure-tightness and Tensile Properties of Sand-cast Bronzes and Gunmetals*

*By A. Cibula, M.A., A.I.M.†*

*The relation between grain size and properties has been studied, using grain refiners developed in previous work. Iron or cobalt boride, or zirconium carbide or nitride, were added to gunmetals containing from 2 to 14 per cent. tin, 2 to 5 per cent. zinc, and 0 to 5 per cent. lead, and to bronzes containing 10 or 20 per cent. lead. The following castings were poured at from 1,040 to 1,180 deg. C.: (a) DTD bars; (b) 5-in. dia. discs, with central bosses; (c) plates 1 in. thick, with ribs on both faces; (d) bars 2¼ in. dia. For comparison, alloys were also cast without grain refiners.*

*Intergranular films of tin-rich eutectoid were more pronounced in the grain-refined castings, but could be eliminated by restricting the tin content to less than 8 per cent. Large intergranular particles of lead in the bearing alloys were also more numerous in the fine-grained castings. In both well-fed and poorly-fed castings, the total porosity was least in alloys of finest grain size. In castings with columnar structures, however, shrinkage porosity tended to concentrate at the centre-line, leaving the skin of the casting sound, whereas in the fine-grained castings porosity was dispersed, leaving little or no sound skin, and largely occurred in layers perpendicular to the direction of feeding. Because of their unfavourable distribution of porosity, grain-refined castings had much poorer pressure-tightness and, generally, mechanical properties.*

*Equiaxial structures produced by the use of a low casting temperature instead of a grain refiner were associated with similarly-poor pressure-tightness. For each type of casting there was a critical pouring temperature at which the macro-structure changed from columnar to equiaxial, accompanied by a dispersion of shrinkage porosity, and satisfactory properties were obtained only with higher casting temperatures.*

*The results suggest that the mode of solidification of bronze and gunmetal castings varies considerably with pouring conditions. Solidification in alloys cast at high temperatures without a grain refiner proceeds largely by skin-growth, whereas when grain refiners are introduced or the metal is cast at a low temperature, equiaxial grains are nucleated throughout the casting and "pasty" solidification occurs.*

## I. INTRODUCTION AND SUMMARY

Little has been published about the influence of grain-refinement on the properties of cast copper alloys, although grain size is known to have important effects both in other cast alloys and in the wrought copper alloys.[1-13]

Northcott[1] observed that the refinement of several cast, single-phase copper alloys caused an increase in strength and a fall in ductility, which he associated with the obstruction offered by grain-boundaries to deformation. Similar effects are observed in *wrought* brasses.[2]

Others have noted an increase in both strength and ductility caused by a reduction of grain size in cast aluminium-bronzes[3] and beta-brass,[4] and the high mechanical properties of the iron-containing high-tensile brasses are believed to be partly due to their fine macrostructures. Grand,[6] however, found that the static tensile properties of beryllium bronze are not influenced by grain-refinement, though the fatigue limit may be raised as much as 40 per cent., and Corson [7] has pointed out that the properties of cast copper are improved by grain-refinement only when the castings contain harmful porosity.

Evidence on the influence of grain size in cast tin bronzes and gunmetals is conflicting. Goedertz[8] and Vanick[9] suggest that mechanical properties and pressure tightness may be improved by grain-refinement in several alloys whereas Bailey,[10] Ames and Kahn[11] and Eastwood and Kura[12] found that bronze and gunmetal castings poured at low temperatures were fine-grained but possessed poor mechanical properties, owing to the formation of intergranular networks of eutectoid and angular lead particles, which, it was suggested,[11] was associated with a change in the mode of solidification. It is not clear, however, whether the poor properties were due to the fine grain sizes or to the low casting temperature used to produce refinement, or whether the deterioration in properties could have been prevented by reducing the tin and lead contents of the alloys. It is sometimes stated by foundrymen that pressure tightness

* Paper presented at the International Foundry Congress in London last week. The work described in this Paper was made available to members of the British Non-Ferrous Metals Research Association in a confidential research report issued during 1953.

† Research investigator, British Non-Ferrous Metals Research Association, London.

*Grain Size of Bronzes and Gunmetals*

in gunmetal castings is assisted by the use of high pouring temperatures, which would produce a *coarse* macrostructure, but again it is uncertain whether the improvement described is a grain-size effect.

Considerably more information has been published on cast light alloys,[13] which shows that grain-refinement greatly improves feeding properties and resistance to hot-tearing during solidification and raises the tensile properties of the castings. As it seemed possible that similar effects could be produced in copper alloys, grain-refining additions have been developed (as described in another paper[14]), by means of which the grain size can be varied in castings poured at a constant temperature. Several of these grain refiners—zirconium carbide or nitride and cobalt and iron borides—have been used in the present work to study the influence of grain size on (1) the tensile properties and pressure tightness of leaded and lead-free gunmetal sand-castings, and (2) the distribution of lead in leaded-bronze bearing alloys.

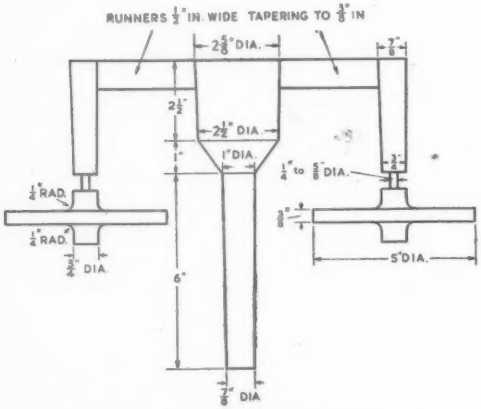



FIG. 1.—*Disc castings and DTD bar.*

In these experiments, degassed gunmetals containing 2 to 14 per cent. tin, 2 to 5 per cent. zinc and 0 to 5 per cent. lead were poured at temperatures between 1,040 and 1,180 deg. C. into green sand moulds, as described in Section II. The following castings were made:—(*a*) DTD bars; (*b*) poorly fed discs (½-in. thick) with central bosses, of which the pressure tightness was measured; (*c*) 1-in. thick plates with ribs on both sides, from which, after testing for pressure tightness, specimens including the porous heat centre in their gauge length were cut for the determination of porosity and tensile properties. The distribution of lead was studied in 1-in. and 2½-in. dia. sand-cast bars of copper/5 per cent. tin/20 per cent. lead and copper/10 per cent. tin/ 10 per cent. lead alloys. The following observations were made.

The alpha/delta eutectoid tended to form brittle intergranular films at high tin contents: this tendency was greater in the refined castings, as a smaller proportion of the eutectoid occurred at grain boundaries in the coarse-grained alloys. The formation of intergranular films could be prevented, however, by restricting the tin content to 10 per cent. or less in the coarse-grained and 8 per cent. or less in the fine-grained castings.

The grain size had a similar influence on the structure of the leaded bearing alloys. Lead tended to

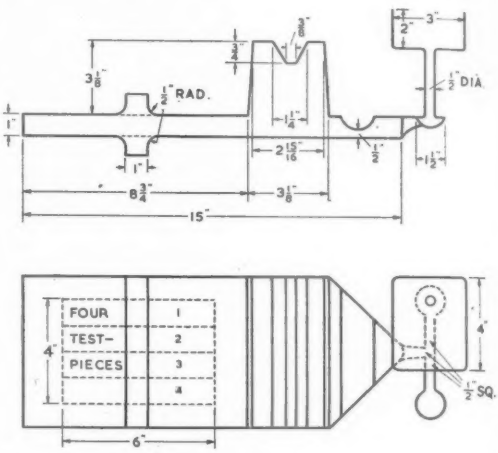



FIG. 2.—*Ribbed-plate casting.*

form large angular particles at the grain boundaries, particularly in the 2½-in. dia. casting and at the higher (20 per cent.) lead content, and the finest distribution of lead occurred in the coarse-grained bars, in which the lead was largely dispersed between the dendrite arms and the proportion of intergranular particles was small.

The grain size had a more important influence on the form and distribution of porosity. Although the total amount of porosity was least in the castings of finest grain size, owing to more complete feeding, the form and distribution of the voids was most deleterious. In the castings with mainly columnar macrostructures, poured at 1,150 to 1,180 deg. C., shrinkage porosity tended to concentrate near the centre-line, often as a pipe, and although the remainder of the voids was dispersed between the dendrite arms, the metal near the surface of the casting was sound; as a result, the coarse-grained disc castings were generally pressure-tight, even when the sound skin was almost penetrated by hot tears. In the fine-grained castings, on the other hand, shrinkage porosity was dispersed throughout the section and there was little or no sound skin, with the result that none of the castings was pressure tight; moreover, much of the intergranular porosity occurred in layers perpendicular to the direction of solidification, presumably owing to tears formed at the end of mass-

feeding,* and these not only added to the lack of pressure tightness but also had a more harmful influence on mechanical properties than did the microporosity in coarse-grained alloys.

Identical effects were observed in alloys refined by casting them at lower temperatures without a grain-refining addition; when the pouring temperature fell sufficiently to produce a coarse equiaxial instead of a largely columnar macrostructure, shrinkage porosity became dispersed and the castings leaked. In the disc casting used in the present work the critical pouring temperature at which the transition in macrostructure occurred was as high as 1,130 to 1,150 deg. C.

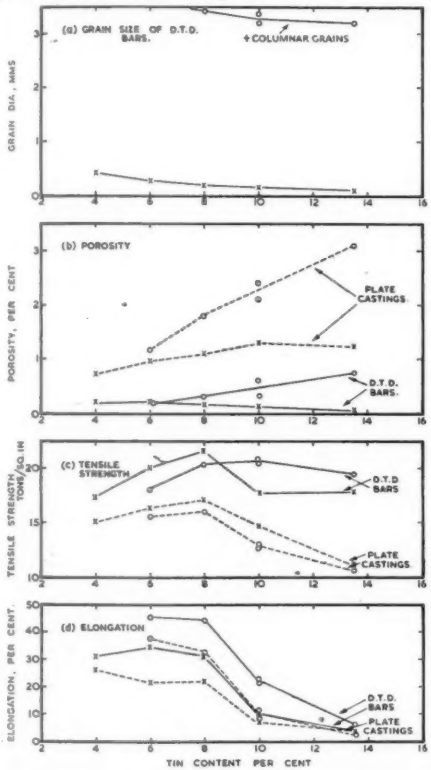



FIG. 3.—*Effect of the addition of* 0.06 *per cent. zirconium on grain size, porosity, tensile strength and elongation of gunmetal castings containing* 2 *per cent. zinc and* 4 *to* 13.5 *per cent. tin, poured at* 1,150-1,180 *deg. C.* (o—— - - -o *unrefined;* x—— - - -x *refined by* 0.06 *per cent. Zr additions).*

The observed macrostructures suggest that the mode of solidification of bronze and gunmetal castings varies considerably with pouring conditions. Solidification in alloys poured at a high temperature proceeds largely by the growth of a coherent skin, whereas when nuclei are introduced, either in grain-refining additions or as particles frozen in the pouring stream, equiaxial grains are nucleated in front of those growing from the surface and pasty solidification occurs. In order to avoid the harmful porosity and poor properties associated with the latter mode of solidification, casting temperatures must be used which are high enough to induce freezing by skin formation; the casting temperature required would be reduced by any factor which limits the fall in temperature and degree of turbulence in pouring, and lower casting temperatures would, therefore, be permissible in large castings with short runners and well-designed gates.

When zirconium additions were used for refinement, gas absorption due to any mould reaction which may have ensued was more than masked by the increase in density due to improved feeding. When iron or cobalt boride were used, however, very severe mould reaction occurred, and the absorbed hydrogen made the layer porosity formed in the fine-grained alloys during solidification even more pronounced.

The influence of a controlled degree of mould reaction (produced by an addition of 0.08 per cent. phosphorus) on the pressure tightness of a few disc castings in 85/5/5/5 alloy was studied; it was found that no improvement was obtained either in zirconium-refined castings poured above 1,150 deg. C. or in castings without a refiner poured at 1,140 deg. C. or less. As the favourable influence of gas absorbed from mould reaction should be greatest at low casting temperatures, whereas the most favourable macrostructures are obtained above a critical pouring temperature (which varies with the casting), an optimum casting temperature may exist at which the best combination of the effects of controlled mould reaction and columnar macrostructure

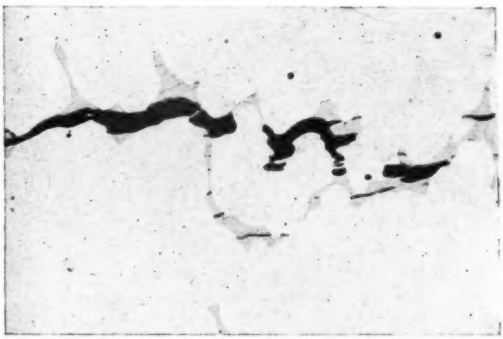


FIG. 4.—*Fracture through layer of intergranular eutectoid, in a broken test-piece of Cu*/10 *per cent. Sn*/2 *per cent. Zn alloy refined with* 0.06 *per cent. Zr and cast at* 1,180 *deg. C. (unetched,* × 500).

* "Mass-feeding" is the stage of solidification when the feed-metal moving towards the cooler parts of the casting consists of solid dendrites floating or suspended in the residual liquid. "Layer-porosity" is illustrated in Figs. 16 and 17. Both terms are discussed more fully in Section IV.

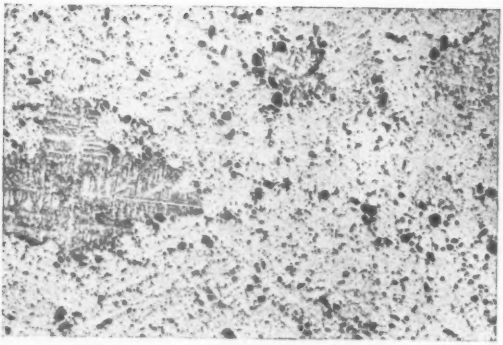


FIG. 5.—*Large intergranular lead particles (black) in coarse-grained 2¼-in. dia. bar of Cu/5 per cent. Sn/20 per cent. Pb alloy sand-cast at 1,150 deg. C. (lightly etched in alc. $FeCl_3$ soln, × 10).*

are obtained. In previous industrial trials,[15] however, an optimum temperature has not been detected and, in view of the marked influence of macrostructure observed in the present work, further study of the influence of casting temperature on the pressure tightness of industrial castings seems desirable.

A comparison of the properties of copper and aluminium casting alloys of long freezing range is made in Section IV and information on the maximum densities of gunmetal castings is recorded in the Appendix.

## II. EXPERIMENTAL PROCEDURE

### Materials

All alloys were made from the master alloys and high-purity metals listed in Table I.

Two types of refining additions were used:—

(*a*) Zirconium additions: other work[14 16] showed that very fine grain sizes were produced by zirconium only in the presence of carbon or nitrogen and in the absence of sulphur; consistent refinement was obtained using the technique described below in which the melts were degassed with nitrogen introduced through a graphite tube. An addition of 0.02 to 0.03 per cent. zirconium was sufficient to produce the finest grain sizes but 0.06 per cent was used in most melts to allow for possible losses due to oxidation.

(*b*) Iron or cobalt boride; additions of 0.005 to 0.05 per cent. boron were made together with 0.15 per cent. iron or 0.2 per cent. cobalt to precipitate small boride crystals in the melt.

Many of the alloys were cast without refining additions for comparison.

### Melting and Casting

Melts of 40 to 45 kg. were prepared in Salamander crucibles in a gas-fired injector furnace. When the tin, zinc and lead had been added, the melts were heated to 1,260 to 1,300 deg. C. and degassed with a stream of nitrogen for 7 minutes at 7 litres per min. The alloys were then deoxidized with 0.03 per cent. phosphorus and the refining additions, when required, were made immediately before pouring. Most of the melts were cast at 1,150 to 1,180 deg. C. but a few alloys were poured at lower temperatures.

### Castings and Examination

The following castings were made from the gunmetal melts in green Mansfield sand containing 5½ to 6½ per cent. moisture:

(*i*) DTD bars (1-in. dia.) of which the grain sizes and densities were measured; the tensile strengths and elongations were then determined on 0.564-in. dia. test-pieces machined from the bars.

(*ii*) Discs of 5-in. dia. and ⅜-in. thick, which had ¾-in. dia. bosses on both top and bottom faces. A narrow vertical ingate into the upper boss restricted feeding, creating shrinkage porosity in and between the bosses; a ⅜-in. dia. gate was used with the lead-free gunmetals, and ¼-, ⅛-, ½- and ⅝-in. dia. gates with the leaded alloys. The complete dimensions of the discs, two of which were attached by runners to the head of each DTD bar, are given in Fig. 1.[17]

The pressure tightness of the unmachined discs was tested by applying compressed air at 80 lb. per sq. in. to one face and Teepol solution to the opposite face.

TABLE I.—*Composition and Preparation of Alloys.*

| Metal or alloy. | Mark. | Purity or alloy content. | Impurities. | Source or method of preparation. |
|---|---|---|---|---|
| Copper | — | > 99.99 per cent. (excluding oxygen and sulphur) | Only Ag. *c.* 0.001 detected spectrographically in several batches | Commercial electrolytic. |
| Tin | — | (i) Approx. 99.8 | 0.065Pb, 0.028Sb, 0.01Bi, 0.005Fe, 0.025 As in typical batch | Mellanear refined stick tin. |
| | | (ii) 99.9 | — | Pass No. 1. |
| Zinc | — | >99.99 | 0.001 Fe, 0.002 Cd. | Crown Special. |
| Lead | — | >99.99 | — | Tadanac ingot. |
| Copper/boron | OXO5 | 5.2B | 0.45 Mg, 0.15 Fe, 0.1 Si | Commercial alloy. |
| Copper/zirconium | OXX1 | 9.6Zr | 0.1 Fe, 0.01Al, Mn, Si and Sn | Commercial Zr sheet dissolved in molten Cu. at 1100 deg. C. |
| Copper/iron | CH12 | 12.0Fe | — | Swedish ingot iron dissolved in molten Cu. at 1,400 deg. C. |
| Copper/cobalt | OHM1 | 13.9Co | — | Electrolytic Co. (99.9 per cent.) dissolved in molten Cu. at 1,300 deg. C. |

(*iii*) A 1-in. thick plate attached at one end to a blind feeder; two 1-in. thick ribs on the top and bottom formed a severe heat-centre across the centre of the plate. The complete dimensions of the casting are shown in Fig. 2; in castings refined with iron or cobalt boride a simple 1-in. dia. down-runner from the pouring basin into the end of the plate was used, but as this created excessive turbulence in pouring it was replaced, in later experiments with zirconium additions, by the smaller down-runner and the runner bar shown in Fig. 2.

After removal of the feeder, ribs and edges, the plate was machined on both sides to $\frac{7}{8}$ in. thick and pressure-tested as above. It was then cut into four 1-in. wide slices through the porous heat-centre; the density and macrostructure of one slice were determined and the tensile strengths and elongations were measured on 0.564-in. dia. test-pieces machined from the others.

(*iv*) A 2-in. dia. cylinder cast into a sand sleeve on a copper block, from which a 1-in. thick slice was cut $\frac{1}{4}$ in. from the chilled face. From the difference between the density of this well fed slice and the density of a casting, a measure of the porosity in the latter was obtained.*

From the bearing alloys of high lead content, 1-in. dia. DTD bars and 2¼-in. dia. bars, 4 in. long and with the appropriate feeder-heads, were sand-cast. The distribution of lead was studied in transverse sections from the middle of the bars and tensile strengths and elogations were determined on test-pieces machined from the smaller bars.

## III. STRUCTURE, PRESSURE TIGHTNESS AND TENSILE PROPERTIES OF BRONZE AND GUNMETAL CASTINGS

### Grain Size

The macrostructures of the unrefined alloys poured at 1,150 deg. C. or above were predominantly columnar, the leaded alloys having the finest columnar grains. When the casting temperature was lowered, the grains became equiaxial, but the pouring temperature with which the transition from columnar to equiaxial structures occurred, varied with the type of casting; in the pressure discs the transition temperature was as high as 1,130 to 1,150 deg. C., owing to the rapid loss of heat which occurred in the runners. The change in macrostructure had an important influence on the properties of the castings, as described below.

The alloys containing 0.06 per cent, zirconium were consistently fine-grained, the grain size decreasing with increasing tin content (as shown in Fig. 3a) and, to a smaller extent, with lead content.

The grain sizes of the alloys containing iron or cobalt were 0.4 to 0.7 mm. when the boron addition exceeded 0.02 per cent., as found in other work.[14] Because of the pronounced mould reaction which also occurred, the properties of these alloys are considered separately below.

* See Appendix on densities of the alloys.

### Distribution of Eutectoid

The angular particles of alpha/delta eutectoid were dispersed partly along the grain boundaries and partly between the dendrite arms and, as the tin content increased, tended to link up into brittle films which were particularly prominent at the grain boundaries. Such films naturally had a deleterious effect on ductility, as indicated by the microstructure of a fractured tensile test-piece illustrated in Fig. 4.

The tin content at which the fall in ductility occurred varied with the grain size because as the grain size was reduced and the dendrite arms became shorter, the proportion of eutectoid at grain boundaries increased; this more than counterbalanced the increase in grain boundary area which accompanied refinement, with the result that intergranular films were most pronounced, at a given tin content, in the alloys of finest grain size, as noted by previous workers[10 11 12]. However, the films of eutectoid were not observed when the tin content was 10 per cent. or less in the coarse-grained alloys and 8 per cent. or less in the fine-grained.

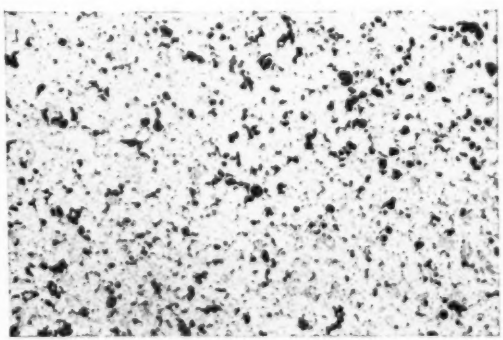
### Distribution of Lead

The grain size had a similar influence on the distribution of lead in leaded bronzes and gunmetals, though the particles of lead had little tendency to form films.

In the casting alloys containing up to 5 per cent. lead, the intergranular particles were lens-shaped or angular whereas those within the grains were more globular, but the two types of particles did not differ significantly in size and probably had similar effects on the properties of the castings whether these were fine- or coarse-grained.

When the lead content was high, however, as in the copper/5 per cent. tin/20 per cent. lead bearing alloy, the intergranular particles were often much larger than those within the grains, as shown in Fig. 5 of a 2¼-in. dia. bar of a coarse-grained alloy;

FIG. 6.—*Numerous intergranular lead particles (black) in fine-grained, 2¼-in. dia. bar of Cu/5 per cent. Sn/20 per cent. Pb alloy sand-cast at 1,150 deg. C. (lightly etched in alc. $FeCl_3$ soln., × 10).*



the distribution of lead in the fine-grained castings, in which intergranular particles were more numerous, was therefore coarser, as shown in Fig. 6. The difference between the coarse-grained and refined alloys was smaller in the 1-in. dia. bars (as shown in Figs. 7 and 8) and in the 10 per cent. tin/10 per cent. lead alloy. The coarse particles of lead were probably partly responsible for the fall in tensile strength and elongation from 12.2 tons per sq. in. and 21 per cent. in the coarse-grained DTD bars to 10.5 tons per sq. in. and 15 per cent. in the fine-grained bars of the 5 per cent. tin/20 per cent. lead alloy; a deterioration in bearing properties might also be expected, though evidence of this has not been sought.

## Porosity

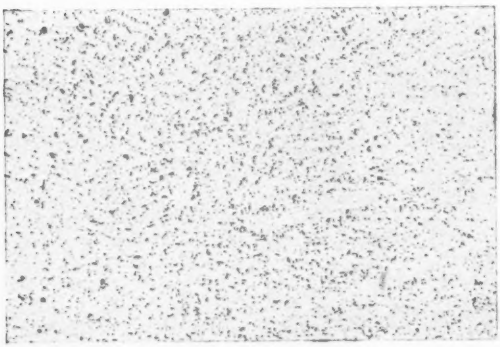
The influence of grain refinement on the porosity of the castings was very marked.

(*a*) *Coarse-grained alloys.*—In the unrefined alloys of columnar macrostructure, the following features in the distribution of porosity were observed:

(i) In the poorly-fed discs and ribbed plates, much of the porosity occurred in gross form near the heat-centre. Where the restriction on feeding was severe as in the discs with $\frac{1}{4}$- and $\frac{3}{8}$-in. dia. gates, secondary pipes were formed as shown in Fig. 9 and (at a higher magnification) to the left of Fig. 10; when feeding was improved by enlarging the gates to $\frac{1}{2}$- or $\frac{5}{8}$-in. dia. the pipe was replaced by coarse interdendritic porosity as shown to the right of Fig. 11. In the plate castings porosity was generally of the second type.

(ii) A zone of fine microporosity extended from close to the pipe or centre-line porosity towards the surface of the casting (see Fig. 10). The voids were almost entirely dispersed between the dendrite arms and, even in regions of intense microporosity, showed little tendency to form continuous layers extending along the grain boundaries.

FIG. 7.—*Distribution of lead in coarse-grained, 1-in. dia. bar of Cu/5 per cent. Sn/20 per cent. Pb alloy sand-cast at* 1,150 *deg. C.* (*unetched,* × 10).



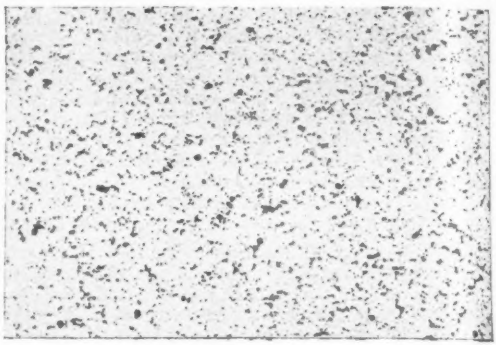


FIG. 8.—*Distribution of lead in fine-grained, 1-in. dia. bar of Cu/5 per cent. Sn/20 per cent. Pb alloy sand-cast at* 1,150 *deg. C.* (*unetched,* × 10).

(iii) Between the zone of microporosity and the surface of the casting was a layer of metal almost free from voids, which extended into the casting for about $\frac{1}{8}$th to $\frac{1}{4}$th of the section thickness. In the poorly-fed disc castings, the sound zone was partly penetrated by intergranular hot tears around each boss, as shown in Figs. 9, 10, 12; these tears were probably formed by the collapse of the skin of the casting into the underlying shrinkage cavities, as they did not occur when the pipe was eliminated by enlarging the gates (Fig. 11). The sound skin was partly obscured by particles of lead in sections of the leaded alloys, as indicated in Fig. 11 (in which the finest dots represent lead), but the radiograph (Fig. 13) of a ribbed plate in leaded gunmetal confirms that the lead-rich skin of the castings contained very little porosity.

(iv) Scattered microporosity was observed in the well-fed DTD bars, close to the top of the bar; such porosity is probably responsible for the fairly wide scatter commonly obtained in the tensile properties of gunmetal DTD bars.

(*b*) *Fine-grained alloys.*—The overall porosities of the zirconium-refined castings were generally smaller than those of the corresponding coarse-grained alloys, as shown in Fig. 3(*b*) and Fig. 14(*a*). The difference was particularly marked when the tin content exceeded 6 per cent. and was observed not only in the poorly fed discs and plate-castings but also in the DTD bars. The greater soundness of the zirconium-refined alloys indicated that any mould reaction effects caused by the additions were slight.

More important differences were observed in the *distribution* of porosity in refined and coarse-grained castings, the principal features of the fine-grained alloys being the following:—

(i) The porosity was distributed over almost the entire cross-section of the poorly-fed regions of the castings, although it tended to concentrate in broad patches (compare Fig. 9 and Fig. 15).

(ii) The voids were mostly intergranular and many of them formed in layers perpendicular to the

FIG. 9.—*Section through coarse-grained pressure-disc in Cu/10 per cent. Sn/2 per cent. Zn gunmetal, cast at 1,170 deg. C. through ⅜-in. dia. ingate (removed before sectioning) (unetched, full size).*

direction of feeding. Layer porosity could be detected even in the DTD bars (see Fig. 16) and was very prominent in the poorly-fed castings (compare Fig. 17 and Fig. 11).

(iii) The metal near the surfaces of the castings was generally unsound, in contrast with the coarse-grained alloys. In the 1-in. thick plate castings there was some tendency for a sounder skin to form round the porous regions but even this was so thin that it was removed in machining $\frac{1}{16}$ in. from each surface of the plate (compare Fig. 18 and Fig. 13).

(iv) Most of the fined-grained castings were free from hot tears.

Reasons for the differences in distribution of porosity in fine-grained and coarse-grained castings are suggested in Section IV.

### Pressure Tightness

The changes in the distribution of porosity caused by grain-refinement produced a great deterioration in pressure tightness, as shown in Table II.

The pressure tightness of the columnar zirconium-free castings depended largely upon the continuity of the sound skin. Where this was completely penetrated by hot tears round the boss of the disc casting, leakage occurred, but when the casting temperature was 1,150 deg. C. or above the sound skin was generally thick enough to isolate tears even as severe as those illustrated in Fig. 12. The coarse-grained plate castings, in which hot tears did not occur, were all pressure tight.

Leakage through the *fine-grained* discs and plates was due not only to the absence of a continuous sound skin, but also to the concentration of porosity in layers. Neither a reduction in casting temperature to 1,050 deg. C., nor the addition of 0.08 per cent. phosphorus to induce gas pick-up from mould reaction produced any improvement in the pressure tightness of fine-grained castings.

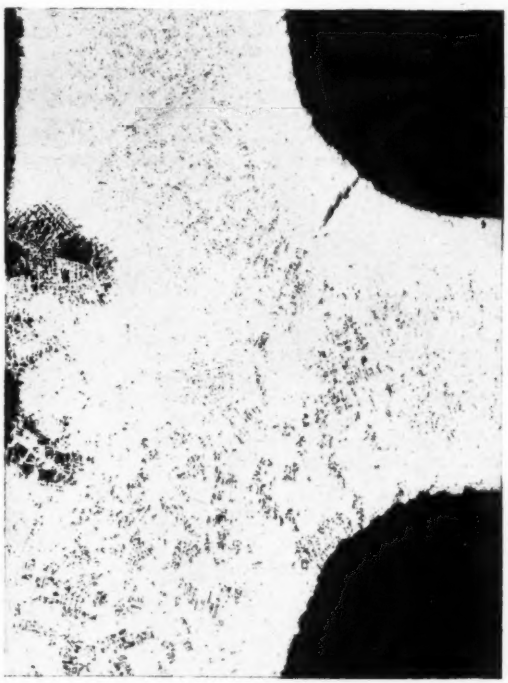
TABLE II.—*Pressure-tightness of Disc Castings in Coarse-grained and Refined Gunmetals Cast at 1,150 to 1,180 deg. C.*

| Composition, per cent. | Gate diameter, in. | Leakers, per cent. (Total number of castings in brackets). | |
|---|---|---|---|
| | | Unrefined. | Zirconium refined. |
| A. *Lead-free alloys* | | | |
| 2 Zn/4 and 6 Sn | ⅜ | 100 (8) | 100 (8) |
| 2 Zn/8 Sn | ⅜ | 50 (4) | 100 (4) |
| 2 Zn/10 Sn | ⅜ | 22 (18) | 100 (4) |
| 2 Zn/13.5 Sn | ⅜ | 0 (4) | 100 (4) |
| B. *Leaded alloys* | | | |
| 85/5/5/5 | ½ | 0 (23) | — — |
| | ¼ | 29 (34) | 100 (16) |
| 88/5/5/2 | ½ to ¾ | 0 (12) | 100 (12) |
| 86/7/5/2 | ¼ | 50 (8) | 100 (8) |

To study the influence of a more moderate degree of refinement, a few discs in 85/5/5/5 gunmetal were cast at 1,150 to 1,180 deg. C. after a small addition of zirconium. Although the refinement produced was only to a coarse equiaxial structure, this was sufficient to eliminate the sound skin and to destroy pressure tightness, as noted in Table III.

The last results suggested that even the small variations in macrostructure caused by changes in pouring conditions of unrefined castings might have significant effects on pressure tightness. Experiments made to determine these effects are described in the next sub-section.

FIG. 10.—*Left-hand side of the section shown in Fig. 9 (×5).*



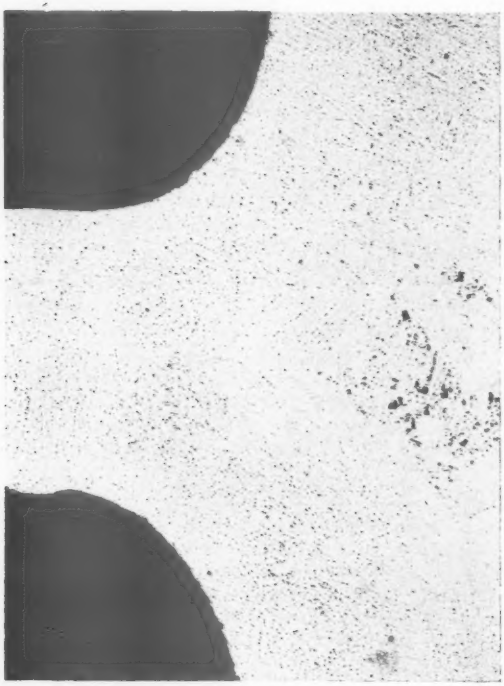


FIG. 11.—*Section through coarse-grained pressure-disc in Cu/5 per cent. Sn/5 per cent. Zn/2 per cent. Pb alloy cast at 1,160 deg. C. through ½-in. dia. gate (finest particles are mostly lead) (unetched, × 5).*

### Influence of Casting Temperature and Mould Reaction on the Structure and Pressure-tightness of Unrefined Alloys

To determine the influence of pouring temperature on macrostructure and pressure-tightness, disc castings and DTD bars in 88/10/2 and 85/5/5/5 gunmetals were poured at temperatures between 1,050 and 1,180 deg. C., without the addition of a grain refiner. Additions of 0.08 per cent. phosphorus (instead of the normal 0.03 per cent.) were made to some of the 85/5/5/5 gunmetal melts to obtain a controlled gas pick-up from mould reaction. The results are summarized in Table IV for the 0.03 per cent. phosphorus alloys.

As the casting temperature was reduced and the macrostructure of the discs changed to equiaxial, the shrinkage pipe became ill-defined or dispersed and the adjacent zone of microporosity more intense and extensive, reaching the surface of the castings in places as shown in Fig. 19 (compare with Fig. 10). As the equiaxial grains became finer with still lower casting temperatures, layer porosity became more pronounced.

Corresponding changes were noted in the pressure tightness of the discs, leaks occurring in almost all castings where the zone of microporosity extended to the surface. The greatest percentage of leakers was found in the discs containing layer porosity. The influence of casting temperature in these experiments was so great that it seems likely that even the small proportion of leaky castings poured at 1,150 to 1,180 deg. C. was due to slight refinement caused by excessive cooling or turbulence during casting.

TABLE III.—*Influence of Degree of Refinement on Pressure-tightness of 85/5/5/5 Gunmetal Disc Castings.*

*Poured at 1,150 to 1,180 deg. C. Through ½-in. Diameter Gate.*

| Zr addition, per cent. | Macrostructure. | Leakers, per cent. (Number of castings in brackets). |
|---|---|---|
| None .. | Mainly columnar .. | 29 (34) |
| 0.01 .. .. | Mainly coarse equiaxial | 83 (12) |
| 0.02–0.06 .. | Fine equiaxial .. .. | 100 (16) |

TABLE IV.—*Influence of Pouring Temperature on Structure and Pressure-tightness of Gunmetal Disc Castings (0.03 per cent. Phosphorus).*

| Casting Temperature, deg. C. | Macrostructure. | Leakers, per cent. (Number of castings in brackets). |
|---|---|---|
| A. 85/5/5/5 *Gunmetal*; ½-*in. diameter gate* | | |
| 1,150 to 1,180 | Mainly columnar .. | 29 (34) |
| 1,130 to 1,150 | Equiaxial and columnar | 79 (14) |
| 1,090 to 1,110 | Moderately fine equiaxial | 83 (18) |
| 1,040 to 1,060 | Fine equiaxial .. .. | 100 (18) |
| ¾-*in. diameter gate* | | |
| 1,150 to 1,180 | Columnar .. .. .. | 0 (23) |
| 1,130 to 1,150 | Columnar and equiaxial | 25 (8) |
| 1,090 to 1,110 | Moderate-to-coarse equiaxial | 20 (10) |
| 1,040 to 1,060 | Fine equiaxial .. .. | 50 (10) |
| B. 88/10/2 *Gunmetal*; ¾-*in. diameter gate* | | |
| 1,150 to 1,180 | Mainly columnar .. | 22 (18) |
| 1,130 to 1,150 | Equiaxial and columnar | 79 (14) |
| 1,090 to 1,110 | Moderately fine equiaxial | 100 (14) |
| 1,040 to 1,060 | Fine equiaxial .. .. | 100 (14) |

The introduction of gas from mould reaction produced a further deterioration in porosity distribution (and no improvement in pressure tightness) in disc castings poured at temperatures below 1,150 deg. C. In discs cast at 1,180 deg. C., on the other hand, early work[17] showed that mould reaction improved pressure tightness by distributing microporosity more uniformly over the casting and reducing the severity of the zone of microporosity round the heat centre.

### Tensile Properties

The tensile properties of the D.T.D. bars and specimens cut from the ribbed plates are plotted in Figs. 3 (*c* and *d*) and 14 (*b* and *c*) for, respectively, lead-free and leaded gunmetals. The sound skin of the columnar castings was mostly removed in machining the tensile test-pieces but the fine-grained alloys nevertheless had generally poorer properties; only in a few lead-free alloys were the fine-grained castings stronger, though less ductile than the coarse-grained. These results indicate that the direct hardening effect of a fine-grain size, such as is observed in wrought copper alloys, is generally less important than the unfavourable influence of layers of porosity when these are perpendicular to the direction of testing. The tensile properties of

FIG. 12.—*Typical integranular hot tears around the upper boss of a coarse-grained pressure disc (deeply etched, full size).*

coarse-grained castings would presumably be even more superior to those of fine-grained alloys if the sound skin were not removed—for example, in an unmachined commercial casting.

In both coarse-grained and refined alloys, the elongation fell sharply when the tin content exceeded 8 to 10 per cent., owing to the changes in the amount and distribution of eutectoid described above.

### Mould Reaction in Boride-refined Alloys

The defects due to grain refinement described above were greatly accentuated in the boride-refined alloys by severe gas absorption from mould reaction.

In the absence of iron or cobalt, boron additions greater than 0.05 per cent. produced only a small increase in porosity and had little effect on grain size or tensile properties; however, in the presence of 0.15 per cent. iron or 0.2 per cent. cobalt (which without boron had no effect), boron additions produced a large increase in porosity, greatly enlarging the layers of porosity in both well-fed and poorly-fed castings and creating also gross longitudinal tears, as illustrated in Figs. 20 and 21. These effects could only be ascribed to the absorption of gas in the mould. Spraying the moulds with aluminium-10 or 33 per cent. magnesium paint increased gas absorption, although this treatment is known to have the opposite effect on mould reaction due to phosphorus in gunmetals.

The fact that the same combination of elements caused grain-refinement and mould reaction was probably a coincidence. It seems likely that mould reaction occurred because the boron addition formed globules of molten borate oxidation products, instead of solid scales which could hinder the reaction between metal and steam in the mould; iron may have accentuated this reaction by forming a highly stable or more fluid oxidation product such as iron borate.

## IV. COMMENT

### Pressure-tightness of Commercial Gunmetal Castings

In the disc castings used in this work, lack of pressure tightness was accentuated by hot tears which penetrated the sound skin. Nevertheless, the influence of macrostructure was so strong that it is probably important even in more fully fed commercial castings, particularly where a machining operation is made, and to avoid the poor properties associated with an equiaxial structure, casting temperatures must be used which are high enough to induce freezing by skin formation.

The high pouring temperature required to produce a satisfactory columnar macrostructure in the pressure disc, however, is unlikely to be typical of many commercial castings as the loss of heat in the open cross-runners to the discs was unusually rapid. The minimum casting temperature required would be reduced by any factor which limits the fall in temperature of the metal during pouring and the degree of turbulence, and lower pouring temperatures would, therefore, be permissible in large castings with short runners and with gates designed

FIG. 13.—*Radiograph of a slice, 0.05 in. thick, through the junction of ribs and plate of coarse-grained Cu/5 per cent. Sn/5 per cent. Zn/5 per cent. Pb gunmetal casting, poured at 1,160 deg. C. (×2.5).*

to allow a smooth flow of metal; whatever the casting, however, a critical range of pouring temperatures must exist, below which pasty solidification would be encountered.

The beneficial influence of controlled mould reaction, on the other hand, is greatest at low casting temperatures, as the absorbed gas then has little opportunity to diffuse into the heat centres. As a result of these two effects, an optimum range of pouring temperatures should exist with which the greatest yield of pressure tight castings would be obtained. In a previous series[15] of industrial trials using controlled mould reaction, however, the lowest

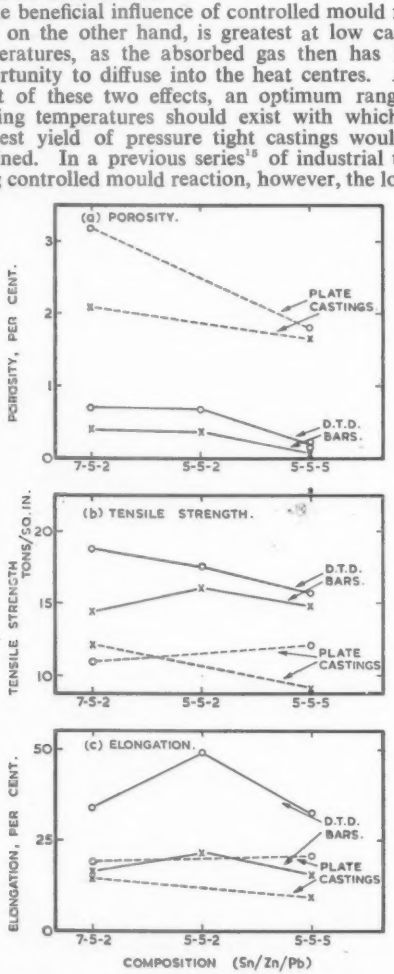



FIG. 14.—*Effect of the addition of* 0.06 *per cent. Zr on the porosity, tensile strength and elongation of leaded gunmetal castings poured at* 1,150-1,180 *deg. C.* (o——- - -o *unrefined;* x——- - -x *refined by* 0.06 *per cent. Zr additions*).

pouring temperatures were found to yield the best results, which apparently contradicts the conclusion drawn above. It is possible that satisfactory columnar structures were obtained in porous regions of these commercial castings when the thinnest sections were just filled, but this is unlikely to be generally the case and further study of the influence of casting temperature seems to be desirable.

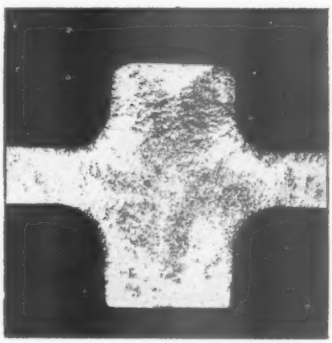
**Mode of Solidification of Gunmetal Sand-castings**

Both modes of freezing described in detail by Ruddle[18 19]—skin formation and pasty solidification—probably occurred in the castings studied in this work. The columnar macrostructures and pipes in gunmetal castings poured at 1,150 to 1,180 deg. C. indicate that such castings solidify largely by skin formation. The change in macrostructure to an equiaxial one as the pouring temperature is reduced, and the accompanying dispersion of shrinkage cavities, indicate that freezing then occurs rather by pasty solidification, proceeding simultaneously from many points throughout the casting.

However, even in castings with completely columnar structures, the solidifying skin, though coherent, may contain a large proportion of liquid metal owing to the long freezing ranges of these alloys. Although the eventual freezing and contraction of the residual liquid near the surface of the casting may be compensated by the flow of liquid from the interior, resulting in a sound skin, feeding becomes less complete when the primary dendrites bridge and the central cavities begin to form, and a zone of microporosity therefore remains near the central voids, as described in Section III. As the tin content of the alloys is raised, the proportion of liquid in the coherent skin at the temperatures of bridging probably becomes larger, and this in turn increases the microporosity of the casting, as indicated in Fig. 3 (b).

The transition from skin formation to pasty solidification as the casting temperature is lowered is presumably due to the increasing tendency for particles of solid metal to form in the pouring stream as it cools or in the still turbulent metal in the mould; such particles would nucleate fresh grains in front of those growing from the surface of the casting and would thus promote pasty solidification. Nucleating particles introduced by means of a grain-refining addition would have the same

FIG. 15.—*Section through a zirconium-refined pressure disc in Cu*/10 *per cent. Sn*/2 *per cent. Zn alloy cast at* 1,170 *deg. C. through* $\frac{1}{8}$*-in. dia. gate* (*unetched, full size*).



effect even with high casting temperatures; this is in accord with the fact that dispersed porosity was observed in the refined castings, as described in Section III, as well as those poured at low temperatures.

The other features noted in fine-grained castings —more complete feeding and the concentration of microporosity in layers perpendicular to the thermal gradient—have been observed in a number of alloys which solidify in a pasty manner. It has been suggested that these features may be explained in the following way.[13 20 21]

In the first stage of solidification, feeding occurs by the movement of liquid metal together with solid dendrites floating in the melt; this has been termed mass-feeding.[20] Eventually the dendrites grow large enough to interlock and form a semi-coherent network, and feeding then continues partly by the movement of the network under hydrostatic and atmospheric pressure, and partly by the flow of residual liquid through the interdendritic channels; as the dendrite arms thicken, however, the network becomes more rigid and the flow of liquid through the narrow channels is obstructed, with the result that feeding becomes increasingly difficult towards the end of solidification. The small dendrites in a refined alloy form a rigid network at a later stage of freezing than the large, angular dendrites in a coarse-grained casting, and grain-refinement therefore prolongs mass-feeding and diminishes porosity, as observed in Section III.

While intergranular films of liquid are present, the network of dendrites is brittle and tears readily under tensile stress,[22] and although some of the tears may be filled by residual liquid, others, particularly those formed near the end of freezing, remain unhealed. The tensile stresses required to tear the network may arise, for example, if the shape of the casting is such that its contraction while cooling through the freezing range is resisted by the mould. The layers of porosity described in Section III and elsewhere[20 21 23] also appear to be incompletely healed tears, presumably caused by non-uniform solidification and cooling contraction: the feeding of pasty metal towards the parts of the casting remote from the feeder is retarded not only by the stiffness of the network of dendrites but also by the restraining influence of metal near the surface, which, being cooler than the interior, is also firmer; consequently, as shrinkage due both to solidification and cooling contraction proceeds within the casting, intergranular tears are formed across the section, at right angles to the direction in which mass feeding would continue if it were not obstructed, and approximately parallel to the thermal gradient. The incomplete filling of these internal tears with feed-liquid results in the layers of porosity shown in Figs. 16, 17 and 18.

FIG. 16.—*Fine layer-porosity near the top of a DTD bar of zirconium-refined Cu/8 per cent. Sn/2 per cent. Zn gunmetal poured at* 1,180 *deg. C.* (*unetched,* ×25).

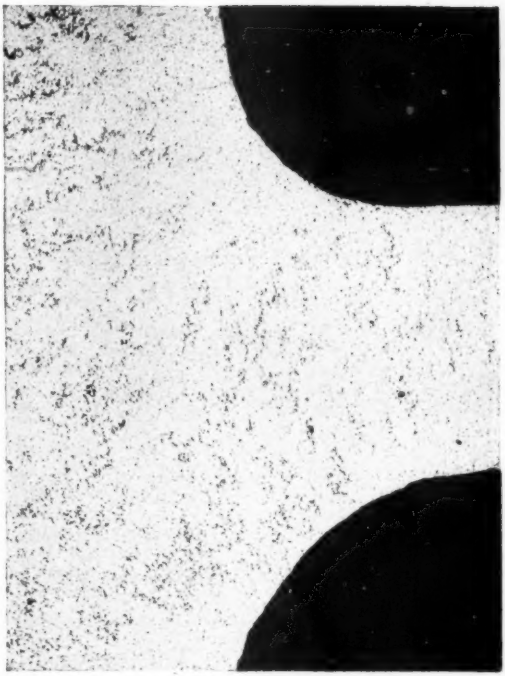


FIG. 17.—*Severe layer-porosity in a section through a zirconium-refined pressure disc in Cu/5 per cent. Sn/5 per cent. Zn/2 per cent. Pb alloy cast at* 1,150 *deg. C. through* ½*-in. dia. gate* (*finest particles are mostly lead*) (*unetched,* ×5).

The formation of layer porosity would be assisted, like other types of porosity, by lack of feeding, by the release of dissolved gas into the voids as they form, and by low hydrostatic and atmospheric pressure. The influence of lack of feeding is illustrated by the difference in the amounts of layer porosity in the DTD bar and the poorly fed disc and plate castings. The influence of dissolved gas is shown by the intense layer porosity which accompanied mould reaction, particularly in the castings containing iron and

FIG. 18.—*Radiograph of a slice, 0.05 in. thick through the junction of ribs and plate in zirconium-refined Cu/5 per cent. Sn/5 per cent. Zn/5 per cent. Pb gunmetal casting poured at 1,160 deg. C.* (× 2.5).

boron illustrated in Figs. 20 and 21. Finally, Parker, Fox and Turner[23] have shown that layer porosity may be eliminated by increasing atmospheric pressure during solidification.

In a casting which solidifies by skin formation, the parts remote from the feeder (or heat centre) are fed by liquid, not pasty metal, and internal tears are therefore not created when the flow of metal is obstructed, centre-line porosity beginning to form instead. However, since the columnar skin forms at an early stage of freezing, it is particularly prone to hot tearing if strained by collapse into underlying cavities or by restraint by the mould.

It is possible, therefore, to distinguish between two types of hot tears; (i) the more commonly observed type which is open at the metal surface and is due to cooling contraction proceeding under an externally applied restraint, and (ii) internal hot tears resulting in layer porosity, which are due to the continuation of both solidification and cooling contractions after mass feeding has become impeded. It may be expected that open hot tears being directly exposed to atmospheric pressure, would be healed by in the inflow of feed-liquid with greater difficulty than internal tears.

### Comparison of Copper and Aluminium Casting Alloys

The great difference between the deleterious effects of grain-refinement in sand-cast bronzes or gunmetals and its beneficial effects in the light alloys of long freezing range, may be explained by the following differences in the structures of the alloys :

(i) The sound skin of the columnar (but not equiaxial) gunmetal castings renders these alloys pressure tight when feeding is far from complete; on the other hand, most light alloys of long freezing range, under normal casting conditions, do not solidify with columnar structures and must be well fed if they are to be made pressure tight. Grain-refinement in light alloys probably improves pressure tightness by assisting mass feeding and hence increasing soundness, in contrast with its bad effects on pressure tightness in gunmetal castings in which it also changes the mode of solidification. (However, no detailed study of the influence of macrostructure on the pressure tightness of light-alloy castings has been made, and it may be possible to obtain columnar macrostructures simply by using titanium-free metal* or casting temperatures high enough to destroy stray nuclei.)

* Commercial aluminium alloys normally contain at least a trace of titanium, which is sufficient to cause some refinement.

FIG. 19.—*Section through a pressure disc in unrefined Cu/10 per cent. Sn/2 per cent. Zn gunmetal, cast at 1,140 deg. C. (unetched,* × 5).

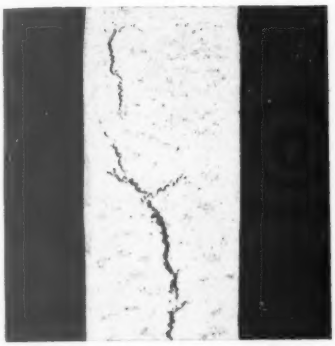
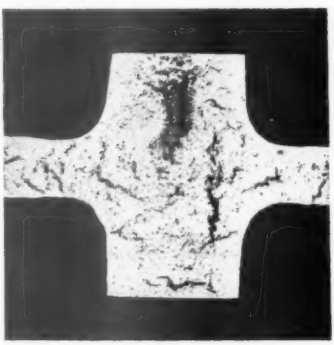


FIG. 20.—*Transverse layer of porosity and longitudinal tears due to mould recation in a DTD bar of Cu/10 per cent. Sn/2 per cent. Zn gunmetal refined with 0.15 per cent. Fe and 0.05 per cent. B and cast at 1,160 deg. C. (unetched, × 1).*

(ii) Shrinkage porosity has little tendency to concentrate at grain boundaries in coarse-grained bronzes or gunmetals, most of it being dispersed between the dendrite arms; in coarse-grained aluminium alloys, on the other hand, microporosity often

FIG. 21.—*Section through a pressure disc in same alloy as that in Fig.* 20 (*unetched,* × 1).



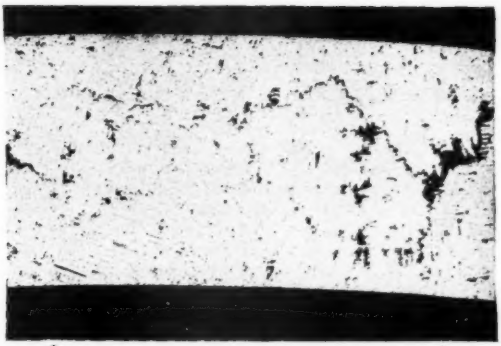


FIG. 22.—*Intergranular porosity in a defective casting in naval brass (etched in aqu. ammon. persulphate,* × 5).

forms harmful intergranular films, and grain-refinement has a beneficial influence in breaking up such concentrations of porosity by increasing the grain boundary area[24]. Coarse-grained copper alloys of shorter freezing range, however, contain intergranular porosity similar to that observed in aluminium alloys (see Fig. 22) and grain refinement may therefore be advantageous in, for example, cast brasses.

(iii) Whereas all the fine-grained bronzes and gunmetals studied in this work contained layer porosity, this feature has been noted only in the aluminium-magnesium alloys (both aluminium- and magnesium-rich) among the light metals[20 21 22].

Grain-refinement reduces open hot tears both in aluminium and in copper alloys, by prolonging the pasty mass-feeding stage of solidification.

## Acknowledgments

The Author is indebted to the director and Council of the British Non-Ferrous Metals Research Association for permission to publish this Paper. He gratefully acknowledges the co-operation of Mr. T. Burchell of Murex Limited (who supplied the boron master alloy), information on leaded bearing metals from Mr. P. G. Forrester of Glacier Metal Company Limited, and the assistance of Mr. J. Fox and Mr. J. Bacon.

TABLE V.—*Experimental and Calculated Maximum Densities of Bronze and Gunmetal Castings.*

| Composition. | Density. | | | |
|---|---|---|---|---|
| | Experimental (each figure is derived from densities of all maximum-density blocks cast in stated alloy). | Equation[25] D = 8.93 − 0.013x per cent. Zn + 0.025x per cent. Pb—0.1x per cent. P | Hanson and Pell-Walpole[26] D = 8.91—0 25x per cent. Zn + 0.017x per cent. Pb − 0.17x per cent. P. | D = 8.93 − 0.016x per cent. Zn + 0.021x per cent. Pb− 0.1x per cent P. |
| Per cent. | g./cc. | g./cc. | g./cc. | g./cc. |
| 90 Cu/10Sn/0.03P .. .. | 8.91 | 8.93 | 8.90 | 8.93 |
| 88 Cu/10Sn/2Zn/0.03P .. .. | 8.88 | 8.90 | 8.85 | 8.90 |
| 88 Cu/8Sn/4Zn/0.03P .. .. | 8.84 | 8.87 | 8.80 | 8.86 |
| 86 Cu/7Sn/5Zn/2Pb/0.03P .. | 8.87 | 8.91 | 8.81 | 8.89 |
| 88 Cu/5Sn/5Zn/2Pb/0.03P .. | 8.88 | 8.91 | 8.81 | 8.89 |
| 85 Cu/5Sn, 5Zn/5Pb 0.03P .. | 8.94 | 8.99 | 8.87 | 8.95 |
| 75 Cu/5Sn/20Pb .. .. .. | 9.25* | 9.43 | 9.24 | 9.35 |

* Specimens taken from bottom half of 2-in. dia. chill-cast bars.

*Grain Size of Bronzes and Gunmetals*

## APPENDIX

### Maximum Densities of Bronze and Gunmetal Castings

The maximum densities of well-fed alloys observed in this work were not quite consistent with formulæ previously used for calculating the density of a leaded gunmetal from its composition[25 26]. The equation given in the last column of Table V appears to give more accurate results for cast bronzes and gunmetals containing up to 5 per cent. lead, indicating a consistent porosity of 0.1 to 0.2 per cent. in the well-fed castings.

A number of maximum-density specimens were compressed to half their height and their densities were redetermined. The increases in density were all between 0.02 and 0.16 per cent., in agreement with the calculated porosities, except in the 20 per cent. lead alloy which increased in density to 9.31 gm. per cc.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## Rapid Estimation of Manganese in Ferro-manganese, Cupro-manganese, Aluminium-manganese, Spiegel and Steels with 12 to 14 per cent.

Several letters received by the *Centre Technique des Industries de la Fonderie* have asked whether it is possible to obtain a manganese result in 15 min. for manganese steels containing 12 to 14 per cent. Mn. The *Centre* has perfected a volumetric method, which is described in what follows. As a result, it has been possible to extend this method to include the estimation of manganese in master alloys such as ferro- and cupro-manganese, aluminium-manganese and spiegels, so long as the chromium is less than 0.50 per cent., which is a normal limit. The precision of this method, without attaining the reliability of the standard reference methods, is quite sufficient to meet the needs of current practice.

### Principle

The principle of the method is as follows:—After dissolving the alloy, the manganese is oxidized to permanganic acid by ammonium persulphate, in a strongly phosphoric condition and in the presence of silver nitrate as a catalyst. The excess of persulphate is destroyed by boiling, the permanganate is directly titrated in the hot solution by a standard solution of sodium oxylate.

*Reagents Used:*

(1) Acid mixture:
Sulphuric acid, $d = 1.83$ : 90 ml.
Phosphoric acid $d = 1.71$ : 240 ml.
Nitric acid $d = 1.33$ : 60 ml.
Water : 860 ml.
(2) Silver nitrate, 24 gm. per litre.
(3) Pure ammonium sulphate.
(4) N/5 Sodium oxalate solution (13.4 gm. per litre of the pure, dry salt).

*Method Used:*

Weight to be taken:

.. for manganese contents of less than or equal to 20 per cent. .. .. 0.50 gm.
.. for manganese contents running between 20 and 50 per cent. .. .. 0.20 gm.
.. for manganese contents higher than 50 per cent. .. .. .. 0.10 gm.

Dissolve the weighed sample in 70 ml. of the acid mixture in an Erlenmeger flask of 500-ml. capacity, carrying a graduation mark at 200 ml. Heat gently until completely dissolved, then allow to boil to remove nitrous fumes. Dilute to 200 ml. with hot water, and then add 15 ml. of the silver-nitrate solution and allow to boil for a minute.

Remove from the hot-plate and add 5 gm. of ammonium persulphate in the form of a salt. Again, carry to a quiet boil, which should be maintained for exactly 5 min. At the end of the operation, shake the flask in both directions to aid the destruction of excess persulphate.

Allow to cool to about 70 deg. C. and titrate with the solution of sodium oxalate until the disappearance of the violet tint of the permanganate. The titration should be finished slowly, as the reaction is by no means instantaneous.

*Example of Calculation:*

Let:

$n$ = the volume in ml. of the N5 sodium-oxalate solution used for the titration;
M = the sample weight in gm.

Then the Mn per cent. $= \dfrac{0.22 \times n}{M}$

BIP CHEMICALS, LIMITED, announce that Axel K. B. Koch, Vestre Boulevard 9, Copenhagen V, are now the appointed agents for "Beetle" foundry resins in Denmark.

# I.B.F. Awards, 1955

## Honours Conferred on Members at the London Congress

The following medal awards for 1955 were announced at the annual general meeting of the Institute of British Foundrymen held at the Dorchester Hotel, Park Lane, London, W.1, on Monday, June 20, and were presented to the recipients by the Rt. Worshipful the Mayor of Westminster at the opening ceremony of the International Foundry Congress at the Dorchester Hotel on the morning of the following day:—

### E. J. Fox Medal

On the recommendation of the assessors, Sir Frederick Scopes and Dr. J. E. Hurst, the Council awarded the E. J. Fox medal for 1955, to L. B. PFEIL, O.B.E., D.SC., A.R.S.M., F.I.M., F.R.S., in recognition of his outstanding services to the foundry industry and metallurgy and in particular for his work on high-temperature alloys. Dr. Pfeil, who for some years was lecturer in Metallurgy in the University College, Swansea, has since 1930 been associated with the Mond Nickel Company, Limited. For 15 years he was in charge of the company's research laboratories at Birmingham, being responsible for direction of major researches on steel, cast iron, and non-ferrous metals. In 1945 he became manager of the development and research department, a position which he still holds. He is also a director of the Mond Nickel Company, Limited, and of its associate, Henry Wiggin and Company, Limited. For many years Dr. Pfeil has also done important work outside his own company; he has given assistance to many research organizations and has been a member of several Governmental committees, among which are the Inter-Service Metallurgical Council and the Metals Economy Advisory Committee to the Minister of Supply. Dr. Pfeil has served on the Council and research committees of the British Cast Iron Research Association, the British Non-Ferrous Metals Research Association, and the British Iron and Steel Research Association. In 1947 Dr. Pfeil was awarded the O.B.E. in recognition of his services in connection with the war effort, and in 1951 was elected to the Fellowship of the Royal Society. He is the author of a large number of papers on ferrous and non-ferrous metallurgy and a member of many scientific and technical societies in the United Kingdom and overseas. He was a member of the Joint Education Committee set up by the Institute of British Foundrymen in collaboration with other metallurgical Institutes.

### Oliver Stubbs Medal

The 1955 award of the Oliver Stubbs medal goes to MR. E. S. RENSHAW in recognition of his outstanding contributions in the field of cupola practice and the readiness with which he has imparted his knowledge to his fellow members of the Institute and associated bodies abroad. Mr. Renshaw received his metallurgical training at Sheffield University and works training at the Sheepbridge Coal and Iron Company, Limited, Chesterfield. He was then employed for three years as assistant metallurgist with the Sheepbridge Stokes Centrifugal Castings Company, Limited. In 1929, Mr. Renshaw joined Henry Ford & Son, Limited, Cork, Eire, as metallurgist and transferred to the Ford Motor Company, Limited, Dagenham, in 1932. Since that time he has been foundry technical superintendent. He has visited the USA on a number of occasions and presented the official exchange paper of the Institute to the American Foundrymen's Society in 1951. A member of the London branch of the Institute, Mr. Renshaw was awarded the diploma of the Institute and the British Foundry Medal in 1951 and has served as a member of a number of technical sub-committees and as chairman of sub-committees T.S.36 and T.S.43 (the latter is still in being) since becoming a member in 1934. He is an associate of the Institution of Metallurgists.

### British Foundry Medal and Prize

The British Foundry Medal and prize of £10 0s. 0d. established by the FOUNDRY TRADE JOURNAL as an annual award to the author of the paper adjudged by the Council to be the best presented to the Institute during the year, has been awarded to MR. JOHN M. LANGHAM, M.A., for his Paper "Founding of Marine Propellers" published in the recently-issued volume XLVII of the Institute's *Proceedings* also FOUNDRY TRADE JOURNAL, September 23 and 30, and October 7, 1954. He is a member of the London branch.

Mr. Langham was educated at Bedford School and Queens' College, Cambridge University, taking the Mechanical Science Tripos. Subsequently, he underwent practical training at Harland & Wolff, Limited, Belfast, and then served for three years as an engineer officer in the Royal Navy. In 1947, he joined J. Stone & Company, Limited, and in 1951 became marine production manager at their Charlton works, engaged in the manufacture of all types of ships' propellers and other marine equipment. Mr. Langham is a member of the Institute and an associate member of the Institution of Mechanical Engineers. He is also an associate of the Institute of Marine Engineers. At the International Congress at Florence last year, he delivered the official exchange paper of the Institute of British Foundrymen also on the subject of the founding of marine propellers.

*I.B.F. Awards*

### Meritorious Services Medal

The Meritorious Services medal for 1955 passes to MR. JOHN G. BAILES in recognition of outstanding work on behalf of the Institute and the Sheffield branch and in particular for the exacting duties he has carried out so efficiently as chairman of the membership committee of the Institute.

Mr. Bailes served his apprenticeship with Blair & Company, marine engineers, of Stockton-on-Tees, and was subsequently employed for 18 years at the works of Head, Wrightson & Company, Limited, Thornaby-on-Tees, as assistant to Mr. J. E. Mercer. For the past 13 years he has held the post of foundry manager of William Jessop & Sons, Limited, Sheffield. Mr. Bailes is a licentiate of the Institution of Metallurgists and is a member of the American Foundrymen's Society. He has served on the Institute's Council for many years and on a number of administrative and technical sub-committees of the Institute. He was president of the Sheffield branch in the 1949-50 session. Amongst other duties which Mr. Bailes has carried out for the Institute is representation on the City and Guilds Advisory Committee on foundry practice and patternmaking.

### First John Bell Scholarship Award

The first award of the John Bell Travelling Scholarship in Metallurgy has been made to DAVID M. CLINTON, of Carluke, Lanarkshire. It will entitle him to undertake a tour of industrial and academic establishments in Britain or abroad. The scholarship was endowed last year from surplus funds from the Glasgow conference of the Institute. It is being administered through the Royal Technical College, Glasgow.

A 22-year-old former pupil of Hamilton Academy, Mr. Clinton plans to use the award to visit industrial plant in Germany. He is a metallurgist in the laboratories of the Clyde Alloy Steel Company, Limited, and is in the final year of a metallurgy course at the Royal Technical College, Glasgow. He first went to the college in 1951, under the Colville combine's "sandwich" scheme, and since then has gained a Governor's Scholarship, the Blyth Memorial Prize in Natural Philosophy, and the Dr. Stockdale Prize in Metallurgy.

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ROLLS-ROYCE jet engine factory at Derby has produced a simple device to overcome the problems of the noise of jet engines. It is a corrugated nozzle which "looks rather like a pastry cutter." It is the result of four years' research, but the designers are not yet satisfied, because only about half the noise is eliminated at present. A set of nozzles has been made for the De Havilland Comet aircraft.

## The Inquiring Mind

Industry is well aware that not the least of its problems to-day is the shortage of science graduates essential to the progress and maintenance of new development. Realizing that the future entrant to industry is to be found in the schoolroom, the Institution of Electrical Engineers has sponsored a documentary film aimed to capture the imagination of the boy at school between the ages of 16 and 18 with a bent for science. In short, the Institution, as the film's title suggests, is attempting to interest "The Inquiring Mind."

Sketching a brief outline of the history of electrical engineering, the film goes on to show many of its applications in everyday use, from lighting in the streets to television in the home, radar, telecommunications, and the generation and harnessing of power, which the world is insatiably demanding. While the romance of the profession is left to make its own impact, the realities of the need for routine research, testing, and maintenance are emphasized, showing how the aspiring electrical engineer makes his way from university or technical college to practical experience on the factory floor and on to any of the large number of departments on which electrical engineering is built. The assistance of the leading industrial electrical engineering concerns, the scientific institutions, and the public corporations has been given in the making of the film, which is being made available, on loan, to schools interested in providing information on a professional career and to other organizations wishing to use it on suitable occasions.

## Iron-ore Imports

Iron-ore imports in May, and the total for the first five months of this year compared with the corresponding period of 1954, are shown below.

| From | Month ended May 31. | Five months ended May 31. | |
|---|---|---|---|
| | 1955. | 1954. | 1955. |
| | Tons. | Tons. | Tons. |
| Sierra Leone .. .. .. | 36,300 | 231,086 | 247,015 |
| Canada .. .. .. .. | 108,938 | 249,054 | 188,208 |
| Other Commonwealth countries and Eire .. .. .. | 1,071 | 15,271 | 5,883 |
| Sweden .. .. .. .. | 262,091 | 1,714,587 | 1,381,100 |
| France .. .. .. .. | 60,459 | 191,966 | 275,093 |
| Spain .. .. .. .. | 61,419 | 212,271 | 328,543 |
| Algeria .. .. .. .. | 229,927 | 880,420 | 968,600 |
| Tunisia .. .. .. .. | 53,395 | 247,236 | 277,159 |
| French Morocco .. .. .. | 27,822 | 129,083 | 115,351 |
| French West Africa .. .. | 48,736 | 285,959 | 277,816 |
| Spanish Morocco .. .. .. | 16,840 | 111,870 | 94,005 |
| Liberia .. .. .. .. | 9,770 | 98,443 | 113,698 |
| Brazil .. .. .. .. | 36,977 | 173,916 | 168,382 |
| Other foreign countries .. .. | 28,579 | 146,577 | 111,195 |
| TOTAL .. .. .. | 982,324 | 4,687,739 | 4,502,048 |

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THERE is good reason behind the public concern about the activities and influence of monopolies. Nevertheless, a great deal of nonsense is talked at times about "rings" and "combines." A statement entitled "Restrictive Business Practices and the Public Interest," published by the Federation of British Industries at 1s. 3d., should help to dispel some of the illusions and misconceptions which are held on this complex subject. It carries the warning that serious harm could be done to productive industry, the national economy, and the public interest if statutory action on restrictive business practices were based on generalizations. The FBI, seeks neither to justify nor condemn restrictive practices on principle, and favours a general system of competitive free enterprise.

### Institute of British Foundrymen

# TECHNICAL COUNCIL*

## Twenty-third Annual Report, to April 30, 1955.

In this report are traced the activities of the Technical Council and its sub-committees during the twelve months ended April 30, 1955. It will be found that one new sub-committee has been appointed to study casting design and five sub-committees have completed their work during the period reviewed. Of the reports of these latter sub-committees two will be presented at the International Foundry Congress to be held in London in June, two will form contributions to an "Atlas of Typical Microstructures" of cast metals which it is hoped to publish during the coming year, and the last, pending decisions yet to be taken, has provided a basis for views put forward for the revision of the British Standard for grey cast iron.

In addition, the Joint Committee on Gases in Cast Iron and the Joint Sands Committee, to the work of both of which the Institute contributes, have prepared reports during the year. The former Committee's report will be presented at the International Foundry Congress, while the report of the Joint Sands Committee dealing with the shatter index and the mechanical analysis of sand has been published jointly by the Institute and the three other organizations represented on the Committee. Of the many contributions which have made possible this encouraging record of work accomplished, none calls for warmer acknowledgment than that of the Joint Iron Council, to whom the Technical Council is deeply indebted for the continuation of the financial grant for the seventh successive year. As a result of this generosity of the Joint Iron Council it has been possible, throughout this period, to provide extended secretarial assistance and to place at the disposal of the technical sub-committees laboratory and research facilities at universities and many other almost indispensable services. A most sincere tribute is also due to the many who have laboured in the field as members of the technical sub-committees. In this category it is not invidious to make special mention of the work of the chairmen whose enthusiasm has continued to be an enlivening influence on the activities of the sub-committees during the past year. It remains warmly to thank the many firms and the Universities of Birmingham and Durham who have co-operated in the past year's work, the latter by their part in the investigations of some of the sub-committees and the former by the facilities they have granted to members of their staffs not only to attend meetings but to carry out experiments in their foundries and laboratories.

It is gratifying to record that the Institution of Mechanical Engineers and the Institution of Production Engineers share the Institute's interest in the effect of casting design and have appointed representatives to serve on the new sub-committee formed to study this subject. During the past year the Technical Council has also enjoyed the help of the British Cast Iron Research Association, the British Steel Castings Research Association, the British Non-Ferrous Metals Research Association, the Light Metal Founders' Association, the Association of Bronze and Brass Founders and the Bronze and Brass Ingot Manufacturers' Association, all of whom have had representatives serving on the technical sub-committees.

The Institute has again been represented during the past year on many important external committees, including the technical committees of the British Standards Institution concerned with the foundry industry, the Joint Sands Committee and the Joint IBF/BCIRA Committee on Gases in Cast Iron. The special thanks of the Technical Council is again expressed to the many members who have represented the Institute on these committees.

The funds which have supported the J. W. Gardom Student scheme for so many years are now almost exhausted and it will not be possible to appoint further students to serve on the technical sub-committees. The Technical Council joins with the many students who have derived great advantages and enlightenment by taking part in sub-committee work in expressing grateful acknowledgment of Mr. Gardom's generosity.

Two earlier ventures of the Technical Council—T.S.35's film and the "Atlas of Defects in Casting"—have again had a successful year. The former has been presented at a number of meetings of technical colleges and other organizations, and sales of the latter have been well maintained. It is interesting to record that a new version of T.S.35's film will be ready for the International Foundry Congress in June and that an enlargement of the "Atlas of Defects in Castings" is being planned for publication in about eighteen months' time.

### Work in Progress

The work of the active sub-committees, including that of the newly-formed sub-committee on casting design, is summarized below:—

*T.S.24—Ingates (chairman—Mr. F. J. McCulloch):*

This sub-committee has now completed a report to cover the terms of reference which were:—

> "To study the influence of the shape and size of ingate and runner systems on the condition of flow of metal into a mould."

This sub-committee's report will be presented for discussion at the International Foundry Congress to

* Presented at the annual general meeting of the Institute held in London on June 20.

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be held in London in June. Following the discussion on this report, the Technical Council will consider whether or not the sub-committee should be asked to undertake further work.

*T.S.32—Internal Stress (chairman—Mr. M. M. Hallett, M.Sc.):*

During the past year cast discs in different dimensions and materials have been prepared and the internal stress distribution is being determined at the University of Durham. This portion of the work is approaching completion. The sub-committee has agreed for some time that work was needed on the effect of casting size on internal stresses. A larger triangular grid has been designed for comparison with the smaller grid on which much of the earlier work (reported at the Buxton and Sheffield conference in June, 1952) was based, but considerable difficulty has been experienced in finding a suitable foundry to machine mould the large grids. This problem has now been solved and it is anticipated that measurements of the internal stress will present little difficulty. Arrangements have been made to take temperature records to measure temperature gradients in the castings during cooling. The aim of the sub-committee is to finish the whole of the experimental work during the summer with the intention of preparing a final report by the end of the year suitable for presentation at the annual conference in 1956.

*T.S.35—Flow of Metal (chairman—Mr. E. M. Currie, F.I.M.):*

During the past year this sub-committee has been engaged on the preparation of a new edition of the film on the flow of metal into moulds. This new film, which will deal with points which were raised during discussions on the first film, will be shown at the forthcoming International Foundry Congress in London.

*T.S.37—Cast-iron Tests and Specifications (chairman—Mr. J. E. O. Little):*

This sub-committee was appointed in March, 1951, with the following terms of reference:

> "To review the British Standards Institution's test specification for cast iron with special reference to: (i) The transverse test for grey iron, with particular reference to the deflection test; and (ii) the relationship of test-bar to actual casting thickness."

Coincidental with the completion of the committee's work and the preparation of its report, the British Standards Institution undertook a review of the British Standard for grey cast iron. Based on sub-committee T.S.37's report, the Institute has submitted views on the revision of the British Standard and pending completion of this revision the disposal of sub-committee T.S.37's report is in abeyance.

*T.S.38—Copper-base Alloy Castings (chairman—Mr. F. C. Evans, F.I.M.):*

Appointed in March, 1951, to investigate the properties obtainable in copper-base alloy castings, having regard to the economical utilization of metals, this sub-committee presented a report at the Blackpool conference in June, 1953. Certain parts of this report were referred to the British Standards Institution for consideration in connection with the revision of BS 1400. It was hoped that following the presentation of the report, the sub-committee would be able to undertake further tests on the mechanical properties of copper-base alloys, but owing to the great difficulties and the very high cost involved in carrying out a comprehensive programme of tests, this matter has had to be extensively reviewed. As a result the committee has put forward the view that work could be usefully carried out on gunmetals and other long-freezing range alloys, with particular reference to the factors affecting the solidification and macrostructure and their effects on the subsequent properties of the castings. This suggestion has been referred to the chairman's advisory panel to consider whether such a research merits priority over other projects, and if it could be carried out within the resources available to the Institute.

*T.S.39—Mould Drying (chairman—Mr. W. J. Colton):*

This sub-committee was formed in March, 1951, with the following terms of reference:

> "To review the factors involved in the drying and skin-drying of moulds, with special reference to the rate of removal of moisture from the mould surface."

An ambitious series of tests has been pursued throughout the past year and the work on radiant heat has been completed as far as it is possible to go without undertaking a major research programme. Many factors considered to have an effect on drying have been examined, such as temperature of drying, temperature distribution throughout the mould, surface temperature in relation to the rate of drying and incidence of cracking, the original moisture content of the sand, and the permeability of the sand. Air circulation is now being studied, and an experimental stove has been placed at the disposal of the sub-committee for this purpose. It is hoped at a later stage to consider the effect of degree of ramming and venting, the type of sand and effect of additives, pressure effects from mould driers, and atmospheric conditions. The possibility of measuring the drying of moulds by an electrical resistance method is also being studied.

*T.S.40—Atlas of Typical Non-ferrous Microstructures (chairman—Mr. A. Logan, F.I.M.):*

As part of a project to publish an "Atlas of Microstructures" covering all cast metals, this sub-committee was appointed in 1951 to prepare the non-ferrous section of this Atlas. It has now completed its work which is being passed to the co-ordinating committee appointed to ensure standardized presentation when the three parts of the Atlas are combined in book form for publication.

*T.S.41—Atlas of Typical Steel Microstructures (chairman—Mr. C. H. Kain, A.M.I.Mech.E., F.I.M.):*

This sub-committee has been concerned with preparing the steel section of the Atlas, and during the past year its work was completed and passed to

the co-ordinating committee referred to previously.

*T.S.42—Atlas of Typical Cast-iron Microstructures (chairman—Dr. Brynmor Jones):*

The cast-iron section of the Atlas has been completed for some time, and is in the hands of the co-ordinating committee.

*T.S.43—Cupola Development (chairman—Mr. E. S. Renshaw, F.I.M.):*

This sub-committee was appointed in December, 1951, as a result of a recommendation of sub-committee T.S.36, the terms of reference being:—

"To investigate the hot-blast system, carburization, desulphurization, water cooling and combinations of these."

The sub-committee presented its first interim report at the annual conference of the Institute held at Glasgow in June, 1954. Since then the sub-committee has been carrying out tests to assess the advantages of hot blast at various temperatures in the hope that it might be possible to recommend the production of a cheaper unit which would be attractive to smaller foundries. This work is proceeding. The use of water cooling, oxygen enrichment and calcium carbide are also currently engaging the sub-committee's attention, and it is hoped that all of these matters will be dealt with in a further report which will be submitted by the sub-committee in due course.

*T.S.44—Receivers (chairman—Mr. S. J. Sargood):*

Also formed in December, 1951, as a result of a recommendation by sub-committee T.S.36, this sub-committee has the following terms of reference:—

"To review the value and effect of receivers, including tapping systems and slag-handling and disposal methods."

During the year the sub-committee has completed most of its work and is now engaged on the preparation of a report which will be submitted to the Technical Council in due course with a view to presentation at the annual conference in 1956.

*T.S.45—Non-ferrous Quality Test (chairman—Mr. A. Logan, F.I.M.):*

Following proposals put forward at the Buxton and Sheffield conference, this sub-committee was formed in September, 1952, with the following terms of reference:—

"To investigate the possibility of developing a suitable fracture test or other quick routine test for assessing metal quality of copper-base and aluminium-base alloys."

During the past year the sub-committee has examined the possibilities of a number of tests designed to assess the quality of molten copper-base and aluminium-base alloys. Despite many disappointments, the sub-committee has now obtained very encouraging results from a constant volume density test, based on the dip sampling method, by which density can be assessed by weighing in air and water. To confirm that the test is a practical foundry tool, operation under production conditions is being undertaken. Work on other tests is in progress and it is hoped during the coming year to examine the usefulness of tests for impurities and other factors. As far as molten aluminium alloys are concerned, by far the best results so far achieved have been with the reduced pressure test which is now considered to have foundry applications.

*T.S.46—Mould Materials (chairman—Mr. J. Hird):*

This sub-committee was formed in September, 1952, its terms of reference being:—

"To investigate the effect of mould materials on the cooling rate in the solidification range of cast metals, with particular reference to cast iron."

During the past year the sub-committee completed its work and its report has been approved by the Technical Council for presentation at the International Foundry Congress in June.

*T.S.47—Foundry Coke (chairman—Mr. D. Fleming):*

This sub-committee was formed in July, 1953, with the following terms of reference:

"To review the present position of the quality of foundry melting coke and to prepare recommendations concerning coke specification and practical tests, including mechanical tests."

As a first step this sub-committee carried out a detailed review of existing literature published since 1920 dealing with the testing and specification of foundry coke and/or the performance of cokes in cupola melting. Most available papers have now been examined and it is hoped that it will be possible to decide what conclusions can be drawn from them to form a basis for future work or direct recommendation by the sub-committee. Stress has been laid on an examination of previous work of both a practical and theoretical nature over a very wide field. The sub-committee has had in mind that as no previous specifications have been adequate, the fullest knowledge of the problem in all its aspects is a necessary pre-requisite to a rational approach to the more specific task of defining coke tests, *i.e.*, the reasons for varying coke behaviour must be understood before requirements for satisfactory behaviour under good conditions can be defined. It is also necessary to know these requirements before suggestions can be formulated on how to test for them. Work along these lines is therefore likely to continue for a considerable time. Much work remains for the future in respect of "strength" requirements and tests, ash content and reactivity and their relationship to thermometric efficiency and carbon pick-up, the relationship between fuel characteristics and melting losses, the question of reasonable levels of sulphur and phosphorus pick-up, etc., and fuel requirements in relation to blast temperature.

*T.S.48—Non-ferrous Surface Finish (chairman—Mr. R. W. Ruddle, M.A., A.I.M.):*

This sub-committee was formed in July, 1953, the terms of reference being:

"To investigate factors affecting the surface finish of sand-cast non-ferrous castings."

During the past year tests have been carried out in various aspects of the field being studied, including the effects of alloy type, venting, hydrostatic head, green and dry sand, mould coatings and sand additions. The possibility of predicting surface

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finish from sand grain size is also being studied and a series of tests with a cylindrical casting for cores is in progress. At a later date the sub-committee hopes to investigate the effect of the finish of the pattern on surface finish and of the method of running and gating.

*T.S.49—Feeding of Castings (chairman—Mr. H. G. Hall, F.I.M.):*

Sub-committee T.S.49 was also formed in July, 1953, and has the following terms of reference:

"To investigate methods of improving and feeding of castings with special reference to increased yield per unit weight of material melted, with due regard to overall economy."

A large programme of tests in various metals has occupied the sub-committee for most of the past year. Standard test-pieces were selected and experiments conducted to determine the most efficient and minimum size of feeder head for the particular design of casting. From this stage tests using a covering material, exothermic sleeves of all thicknesses and heights, and insulating sleeves have been carried out. This work is nearing completion when the further programme of work will be planned.

*T.S.50—Design of Castings (chairman—Mr. J. Blakiston):*

Arising from the presidential address of Mr. John Bell at the Glasgow conference, it was decided at the October, 1954, meeting of the Technical Council to appoint this sub-committee with the following terms of reference:

"To review the problems associated with casting design in relation to foundry production with special reference to (*a*) the moulding and metallurgical considerations involved (*b*) the effect of design on casting defects and on the economical production of castings, and (*c*) the preparation of a report which, with the co-operation of the engineering institutions concerned, may be developed into a code of practice."

Following a preliminary review of the literature of the subject, the sub-committee met in January and reached the conclusion that much of the information which would be required already existed in scattered form. It was therefore decided to make an exhaustive review of the literature and to abstract from it information likely to be of use to the sub-committee. This work is now in progress.

**Election of Chairman and Vice-chairman 1955/56**

At the March meeting of the Technical Council, Mr. A. E. Peace and Mr. J. McPheat were unanimously nominated for re-election as chairman and vice-chairman of the Technical Council respectively for the year 1955/56. This recommendation was unanimously approved at the meeting of the Council held on April 16, 1955.

The report is signed by Mr. A. E. Peace (chairman of the Council).

## Book Review

**Zarys Dziejow Odlewnictwa Polskiego.** (A summary of the History of the Polish Foundry) by K. Gierdziejewski. Published by the Panstwowe Wydawnictwa Techniczne, Stalinogrod, Poland. Price not stated.

Professor Gierdziejewski who is a well-known foundryman in this country as well as in Poland, has traced in this book the story of non-ferrous and iron founding in Poland from its beginnings in the early 16th century up to the end of the first world war.

As was the case throughout Europe, the earliest attempts at casting in Poland were in bronze and were of simple hand tools. These in turn were followed by gun-barrels and church bells. Fine examples of these early guns can still be seen in the artillery museums of Leningrad, Berlin and Stockholm; and a bell of 98 in. dia. by 78 in. high, cast in Krakow in 1520, weighing 9 tons, is still hanging in the Wawel Castle in that city.

The ironfoundry industry began in the late 16th century and expanded rapidly at first—manufacturing shells and guns. During the following century, the industry began to decline and was saved only by the birth of the Industrial Revolution in England and the subsequent development of the factory system.

It is of interest to note that the pioneers of modern ironfounding in Poland were British. As early as 1796, Mr. J. Baildon built and operated, in Silesia, a coke-fired blast furnace. This was the first blast furnace on the Continent to use coke instead of charcoal in the production of pig-iron. In 1831, Baildon built a steel-works in Katowice which is still known as "Huta Baildona." The first iron foundry of the new factory system was built in Warsaw, in 1819, by Joseph Morris—and in the following year Thomas Evans rebuilt a blast furnace in Warsaw and began producing castings from pig-iron. From that date, the associations of Englishmen with Polish foundries continued almost unbroken. In 1873, Morris and Evans combined to establish a new iron foundry in Warsaw; in 1827, William Peacher modernized and began assembling steam-engine components, imported from Britain, in the Aleksander Metal Works in Bialoga. Ten years later he started a machine-tool factory.

Whilst these Anglo-Polish associations prospered in the Western parts of Poland, Eastern Poland then under Russian domination was also developing a rich industry, especially in iron castings. It is perhaps noteworthy that 50 per cent. of the cast-iron production for the whole Russian Empire was being made in Poland in 1914. In that year there were 91 iron foundries in Poland with an annual output of 275,000 tons of finished castings and employing 12,000 workmen.

Of the developments in the industry since that fateful year, Professor Gierdziejewski has neither traced the history nor has he told us, anything of the present situation in Poland. This is perhaps sound diplomacy on his part.

Z. S.

## House Organ

**Renishaw Works Magazine, May 1955.** Published by the Renishaw Iron Company Limited, near Sheffield.

The feature which the reviewer liked most in this mimeographed booklet is the one on the origin of common phrases. Unless it has been done in the past, a similar sort of article on the names of inns is of like interest. For instance, the Cat and Fiddle is supposed to be derived from the "Catelan Fidel." For the rest there is a good mixture of news of the works' social activities, historical matter and light reading.

# News in Brief

THE WORKS and offices of the Polford Engineering Company, Limited, will be closed for annual holidays from July 29 until August 15.

BTH ELECTRO-PNEUMATIC camshaft control equipment will be fitted on 34 all-steel coaches ordered by the Toronto Transit Commission from the Gloucester Railway Carriage & Wagon Company.

A NEW FACTORY is to be built by the Newsum Engineering Company, Limited, Ilkeston, at Hallam Fields. Two acres of land have been bought from Ilkeston Town Council.

ACHESON COLLOIDS, LIMITED, 18, Pall Mall, London, S.W.1, have issued a list of "Dag" dispersions of colloidal graphite and other solids, which is of real use to those having lubrication problems.

THE STAINLESS-STEEL fittings in the kitchens and galleys of the new luxury liner, Empress of Britain, will be made from steel manufactured by Samuel Fox, & Company, Limited, of Stocksbridge.

EXPORTS from the Tees in April rose from 129,047 tons to 130,788 tons, due mainly to larger shipments of steel angles, bars, and plates. Arrivals of iron and manganese ores were reduced, but more coal and scrap was imported.

THE Brightside Foundry & Engineering Company, Limited, Sheffield, held their annual gala on their sports ground on June 25, when over 2,100 employees, wives and children were invited. Over 70 prizes were presented in the evening by Mr. Ambrose Firth, chairman of the company.

CHEMISTS at Dunlop research centre have discovered a special agent which prevents mildew and is now used in all Dunlop's conveyor, elevator and flat transmission belting. Practical tests have proved that the mildew-inhibiting agents will preserve the strength of the fabric throughout the life of the belting.

W. EDWARDS, & COMPANY (LONDON), LIMITED, Manor Royal, Crawley, Sussex, have changed their name to Edwards High Vacuum, Limited. This has been done to stress their association with high-vacuum equipment, which has always been their main activity. To their new factory, they have now added a further 40,000 sq. ft. of manufacturing space.

ROLLS-ROYCE LIMITED, Derby, held their annual schoolboys exhibition on their welfare ground at Derby on June 19 and 20. Many public and local schools sent parties, and the exhibition included products and processes from the workshops, laboratories and offices of the Rolls-Royce organization. A number of working exhibits were on view, and the attention of the boys was called to the firm's apprenticeship training scheme.

THE PRODUCTION of spare parts for Jowett cars, at present carried out at the Idle (Bradford) factory of the American company (International Harvester), will be transferred shortly to Howden Clough, Birstall, near Leeds—probably in about two months. An official of the American firm has given an assurance that the production of Jowett spares would continue as long as there was a demand.

THE THORNCLIFFE WORKS of Newton Chambers & Company, Limited, engineers, Chapeltown, Sheffield, will hold a general election on July 4 to appoint representatives to the various works committees, including departmental production groups. The election is organized along the lines of a national poll and employees are encouraged to vote. When a similar election was held last year 80 per cent. of the employees voted.

AN ORDER for rolling-mill plant has been received recently by British Thomson-Houston to replace a 6,000 h.p. reversing cogging-mill drive supplied to Steel, Peech & Tozer, of Sheffield, in 1919. The full rating of the new motor is 7,000 h.p., 50/100 r.p.m., 1,500 volts, with a cut-out rating of 21,000 h.p. The motor-generator set being supplied with it has a 5,000-h.p. induction motor, three 1,867-kw., 500-volt generators, and a 30-ton flywheel.

MR. H. V. POTTER, chairman and managing director of Bakelite, Limited, will deliver the Chance Memorial Lecture at the annual meeting of the Society of Chemical Industry, at the University, Edgbaston, Birmingham, on July 14. The subject of the lecture will be "Welfare in Industry," and one of the questions to be posed by Mr. Potter is whether provision by the State and industry of comprehensive social and welfare schemes is gradually reducing initiative and killing enterprise.

THIRTY senior apprentices of Rubery Owen & Company, Limited, are leaving on July 9 for a two-week tour of the Rhineland where they will meet German apprentices and visit the industrial plants of the Ruhr. An English-speaking student from Aachen University will be attached to the party for the duration of the stay in Germany to help overcome language difficulties. A further scheme is also being arranged for a one-day tour by ex-apprentices of the Owen organization to a spinning mill at Oldham and other centres of the cotton industry.

FOUNDRY SERVICES, LIMITED, whose present works are in scattered buildings in Long Acre, Nechells, Birmingham, are to open a £175,000 model factory, near Tamworth, in September. A pioneer in its field, the firm has built up a business with a turnover of £2,000,000 a year exporting to 50 countries and with factories in seven. The firm was founded in 1932 by Mr. E. Weiss with Dr. K. Strauss, and now makes 150 different products and has 400 employees. The new factory is at Drayton Manor, the former ancestral home of the Peel family, and includes a £25,000 canteen with dance-floor, stage, and bar.

INDUSTRIAL MEDICAL OFFICERS and nurses in the Midlands, with the staff of the Birmingham Accident Hospital, held their annual conference in Birmingham recently. Mr. W. Gissane, clinical director of the hospital, asked for close liaison between the staff of accident hospitals or departments, and the welfare and personnel management in industry. He went on to say "Industry can help the hospital surgeon to plan treatment, by giving him an indication of the physical strains of a man's job so that both surgery and hospital rehabilitation can be given with a definite return to work objective."

WELCOMING JOURNALISTS on a visit to the works of Steel, Peech & Tozer, Limited, Rotherham, on June 22, Mr. Andrew Jollie, general manager of the firm, said that last year's steel output fell only narrowly short of a million tons. "By 1958 we hope to be producing 1,200,000 tons a year," he said. The visitors saw the new ring-rolling plant, which produces parts for the aircraft and ball-bearing industries, formerly made by hammer forging; the £150,000 forge, designed for speedy operation, minimum handling, and close technical control throughout, which turns out more than 100 railway axles a shift. They were also shown a Quantometer, the first to be installed in a British steel works, and costing about £18,000. It enables accurate analyses of steel samples to be made, and these are conveyed by electronic means to the melting shop in less than ten minutes. The time taken for actual analysis is only one minute.

# Raw Material Markets

## Iron and Steel

Stocks of pig-iron, coke, and scrap at the foundries, which were heavily depleted during the period of the railway strike, are still well below normal, despite the strenuous efforts of producers to distribute promptly available tonnages. Most of the supplies now being delivered are required for current working. It is likely that the effects of the strike period will be felt for some time.

Full order-books are maintained by the engineering and speciality foundries, and new business is forthcoming steadily to keep this section operating to capacity. Larger quantities of hematite are being used because of the shortage of low- and medium-phosphorus irons, but many of the foundries are unable to obtain all the hematite they need to cover the scarcity of the other grades. Production of hematite was restricted during the rail strike and producers are not expected to be in a position to meet all needs for some time.

With improved supplies of ore and coke, production of high-phosphorus iron is being stepped up, but consumers—notably the light and jobbing founders—are pressing for additional supplies. Jobbing founders generally are active, but not all of the light-castings makers are busy.

Regular deliveries of coke are being made, although some grades from the Welsh ovens are scarce.

## Non-ferrous Metals

An easier tone was seen in copper last week; on Friday there was something of a slump when the settlement price declined to £328 10s., with three months £5 10s. lower, at £323. However, in the afternoon values improved on a modest buying movement and the week closed with cash at £334 and three months at £327. On balance, the prompt price dropped by £17 and three months by £11 10s. This setback was a little difficult to follow, the most likely explanation being expectations of an end to the dock strike.

There would appear to be little doubt that a certain amount of metal is being cleared from the ports and this has so far proved sufficient to keep consumers going, and July and August will be short months for many plants. Little buying was in evidence last week and there was not much change in the other metals. Tin lost £1 both positions and lead 5s. and 10s., respectively, prompt and forward. Zinc showed some weakness, rather surprisingly, and there was a loss of 25s. in second half June. Second half September was down 15s.

The Copper Institute in New York has published figures showing that in the United States output of crude copper in May was up by 4,600 short tons, at 106,900 tons, while refined production rose by no less than 12,900 tons to 135,000 tons. Deliveries of refined copper to consumers in May amounted to 124,900 tons, which was 5,000 tons higher than April. No stockpile tonnage was included in this figure. Outside the US, output of crude copper was 135,600 tons, a fall of 2,300 tons on April, while production of refined metal jumped by 14,400 tons to 116,800 tons. Deliveries of refined copper during May were 108,900 tons, a rise of 7,400 tons.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* June 23, £339 to £340; June 24, £328 to £328 10s.; June 27, £333 to £334; June 28, £339 to £340; June 29, £341 10s. to £342 10s.

*Three Months:* June 23, £329 to £330; June 24, £322 to £323; June 27, £326 to £327; June 28, £330 10s. to £331 10s.; June 29, £335 10s. to £336.

TIN, Standard—*Cash:* June 23, £724 to £725; June 24, £723 10s. to £724; June 27, £726 10s. to £727; June 28, £726 to £726 10s.; June 29, £726 to £726 10s.

*Three Months:* June 23, £724 to £725; June 24, £723 10s. to £724; June 27, £726 10s. to £727; June 28, £725 10s. to £726 10s.; June 29, £725 10s. to £726.

LEAD—*Second half June:* June 23, £102 10s. to £102 15s.; June 24, £102 10s. to £102 12s. 6d.; June 27, £102 15s. to £103; June 28, £102 15s. to £103; June 29, £103 to £103 5s.

*Second half September:* June 23, £102 5s. to £102 10s.; June 24, £102 5s. to £102 10s.; June 27, £102 10s. to £102 15s.; June 28, £102 10s. to £102 15s.; June 29, £102 10s. to £102 15s.

ZINC—*Second half June:* June 23, £90 5s. to £90 10s.; June 24, £91 to £91 5s.; June 27, £91 to £91 10s.; June 28, £91 to £91 5s.; June 29, £91 5s. to £91 15s.

*Second half September:* June 23, £91 5s. to £91 10s.; June 24, £89 15s. to £90; June 27, £90 to £90 5s.; June 28, £90 to £90 5s.; June 29, £90 5s. to £90 10s.

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## Spheroidal-graphite Iron Producers

The fifth international meeting of licensed producers of magnesium-treated iron was held, in the Birmingham area, from June 16 to 18. Some 200 people, from 18 countries, took part in the meeting and the associated tours. On June 16 visits were paid to S. Russell & Sons, Limited, Leicester, and Lloyds (Burton), Limited, Burton-on-Trent, and on the morning of June 17, there was a tour of the research laboratories of the Mond Nickel Company, Limited, and a visit to an exhibition of s.-g. iron castings in the Engineering Centre, Birmingham.

The technical sessions were arranged in two parts: the first was held on the afternoon of June 17, the second on the following morning. Dr. L. B. Pfeil, director of the Mond Nickel Company, Limited, and Mr. F. Dickinson, manager of the development and research department, presided at the meetings. Twenty-two papers were presented for discussion, and two films were shown. In accordance with the usual procedure, all the papers had been circulated, in four languages, prior to the meeting, and, as on previous occasions, simultaneous translation of the proceedings greatly facilitated discussion.

The exhibition of s.-g. iron castings, which was open throughout the week, attracted much interest among engineers, foundrymen and metallurgists in the Midlands area. About 100 castings were on view, including items of special interest from many countries. Tests involving bending, twisting, impact and static loading were carried out, to demonstrate the ductility, strength, shock-resistance and high elastic limit of the material.

In addition to the formal discussions, the social events arranged as a part of the proceedings gave ample opportunity for interchange of experience among licensees from the many countries represented. On the evening of June 16, the British S.-G. Iron Producers' Association entertained the delegates and their ladies at a cocktail party at Chadwick Manor Hotel, Knowle, and on the next day the Mond Nickel Company were hosts at dinner at the Grand Hotel, Birmingham. The closing function was a cocktail party held at the Midland Hotel. The programme arranged for ladies accompanying the delegates included a coach tour to Worcester, Malvern and the Vale of Evesham, a visit to Moreton-in-Marsh and Stratford-on-Avon, and attendance at a performance at the Memorial Theatre.

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* Patent Application 32896/58

B·I·P *Write for technical information to B.I.P. Chemicals Limited, Tat Bank House, Oldbury, Nr. Birmingham*

*London Office: 1 Argyll Street, W.1.* *'Beetle' is a trade mark registered in Great Britain and in most countries of the world.*

# Current Prices of Iron, Steel, and Non-ferrous Metals

*(Delivered unless otherwise stated)*

June 29, 1955

## PIG-IRON

**Foundry Iron.**—No. 3 IRON, CLASS 2:—Middlesbrough, £15 12s. 0d.; Birmingham, £15 5s. 3d.

**Low-phosphorus Iron.**—Over 0.10 to 0.75 per cent. P, £17 13s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £18 9s. 3d.

**Scotch Iron.**—No. 3 foundry, £18 2s. 3d., d/d Grangemouth.

**Cylinder and Refined Irons.**—North Zone, £20 4s. 0d.; South Zone, £20 6s. 6d.

**Refined Malleable.**—P, 0.10 per cent. MAX.—North Zone, £21 1s. 6d.; South Zone, £21 4s. 0d.

**Hematite.**—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £18 2s. 6d.; Scotland (Scotch iron), £18 9s. 0d.; Sheffield, £19 7s. 6d.; Birmingham, £19 14s. 6d.; Wales (Welsh iron), £18 9s. 0d.

**Basic Pig-Iron.**—£15 15s. 6d. all districts.

## FERRO-ALLOYS

*(Per ton unless otherwise stated, delivered)*

**Ferro-silicon** (6-ton lots and over).—45 per cent., Si, £40 15s. 0d., scale 15s. per unit; 75 per cent., Si, £63 0s. 0d., Si, scale 16s. per unit.

**Ferro-vanadium.**—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

**Ferro-molybdenum.**—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

**Ferro-titanium.**—20/25 per cent., carbon-free, £161 0s. 0d. to £165 0s. 0d. per ton; 38/40 per cent., £258 0s. 0d. to £262 0s. 0d. per ton.

**Ferro-tungsten.**—80/85 per cent., 16s. 9d. per lb. of W.

**Tungsten Metal Powder.**—98/99 per cent., 19s. 9d. per lb. of W.

**Ferro-chrome** (6-10 ton lots).—4/6 per cent. C, £83 0s. 0d. to £86 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £81 0s. 0d. to £84 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C,* 1s. 11½d. per lb. Cr; 1 per cent. C,* 2s. 0d. per lb. Cr; 0.15 per cent. C,* 1s. 11d. to 2s. 1d. per lb. Cr; 0.10 per cent. C,* 1s. 11d. to 2s. 2d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per b. Cr.

**Metallic Chromium.**—98/99 per cent., 6s. 10d. to 7s. 4d. per lb.

**Metallic Manganese.**—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £259 0s. 0d. to £265 0s. 0d. per ton.

**Ferro-columbium.**—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

**Ferro-manganese** (home).—78 per cent., £53 17s. 6d.

## SEMI-FINISHED STEEL

**Re-rolling Billets, Blooms, and Slabs.**—BASIC: Soft, u.t., £25 5s. 0d.; tested, 0.08 to 0.25 per cent. C, £26 5s. 0d.; hard (0.41 to 0.60 per cent. C), £27 10s. 0d.; silico-manganese, £34 10s. 0d.; free-cutting, £29 6s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 17s. 0d.; silico-manganese, £34 10s. 0d.

* Average 68-70 per cent.

**Billets, Blooms, and Slabs for Forging and Stamping.**—Basic, soft, up to 0.25 per cent. C, £29 13s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 15s. 0d.

## FINISHED STEEL

**Heavy Plates and Sections.**—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £33 11s. 6d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

**Small Bars, Sheets, etc.**—Rounds and squares, under 3 in., untested, £31 19s. 6d.; flats, 5 in. wide and under, £31 19s. 6d.; hoop and strip, £33 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £34 5s. 0d.; black sheets (hand mill), 17/20 g., £43 13s. 6d.; galvanized corrugated sheets, 24 g., £55 4s. 0d.

**Alloy Steel Bars.**—1 in. dia. and up: Nickel, £54 7s. 9d.; nickel-chrome, £76 7s. 9d.; nickel-chrome-molybdenum, £86 8s. 6d.

## NON-FERROUS METALS

**Copper.**—Cash, £341 10s. 0d. to £342 10s. 0d.; three months, £335 10s. 0d. to £336 0s. 0d.; settlement, £342 10s. 0d.

**Copper Tubes, etc.**—Solid-drawn tubes, 3s. 2½d. per lb.; rods, 373s. 3d. per cwt. basis; 20 s.w.g., 406s. 6d. per cwt.

**Tin.**—Cash, £726 0s. 0d. to £726 10s. 0d.; three months, £725 10s. 0d. to £726 0s. 0d.; settlement, £726 10s. 0d.

**Lead (Refined Pig).**—Second half June, £103 0s. 0d. to £103 5s. 0d.; second half September, £102 10s. 0d. to £102 15s. 0d.

**Zinc.**—Second half June, £91 5s. 0d. to £91 15s. 0d.; second half September, £90 5s. 0d. to £90 10s. 0d.

**Zinc Sheets, etc.**—Sheets, 15 g. and thicker, all English destinations, £122 5s. 0d.; rolled zinc (boiler plates), all English destinations, £120 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £103 0s. 0d.

**Brass Tubes, etc.**—Solid-drawn tubes, 2s. 6½d. per lb.; rods, drawn, 3s. 4½d.; sheets to 10 w.g., 331s. 9d. per cwt.; wire, 3s. 2½d.; rolled metal, 317s. 6d. per cwt.

**Brass (Brazing).**—BS1400, B3 (65/35), £212; B6 (85/15), —; BS249, £226.

**Brass (High Tensile).**—BS1400, HTB1 (30 tons), £270; HTB2 (38 tons), £278; HTB3 (48 tons), £285.

**Gunmetal.**—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £296; LG3 (86/7/5/2), £305; G1 (88/10/2/½), £378; (88/10/2/1), £365.

**Phosphor Bronze.**—BS1400, PB1 (AID released), £385 per ton.

**Phosphor Bronze Strip, etc.**—Strip, 461s. 3d. per cwt.; sheets to 10 w.g., 484s. 9d. per cwt.; wire, 4s. 8¾d. per lb.; rods, 4s. 1¼d.; tubes, 3s. 11½d.; chill cast bars: solids 4s. 3½d. cored 4s. 4½d. (CHARLES CLIFFORD, LIMITED.)

**Nickel Silver, etc.**—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 0d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 4¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 3¾d. All prices are net.

**Other Metals.**—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £108 0s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £163 0s. 0d.; aluminium bronze (BS1400), AB1, £342; AB2, £350. Solder, brazing, BS1845, 2s. 10d. lb.; granulated, 3s. 2d. lb.

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FS 14

## Personal

MR. T. POWELL has been appointed deputy managing director of British Acheson Electrodes, Limited, Wincobank, Sheffield.

Dr. A. PARKER, director of the Fuel Research Station at Greenwich, has been elected chairman of the council of the Royal Sanitary Institute.

Sir MILES THOMAS, chairman of BOAC, will perform the official opening ceremony at the Fuel Efficiency Exhibition on October 12.

Mr. W. D. PUGH, an assistant manager with the English Steel Corporation, Limited, Sheffield, has dug up a Bronze Age flint lance point in the garden of his home.

BRITISH INSULATED CALLENDER'S CABLES, LIMITED, announce the appointment of Mr. H. H. DAKER, B.SC., A.M.I.E.E., C.P.A., as Patents officer in succession to the late Mr. R. L. Cleaver.

Mr. P. D. CROWTHER, who, since 1951 has been in charge of the metallurgical branch of Peglers, Limited, brass founders, etc., Doncaster, has been appointed a director of the company.

Mr. JOHN H. NEAL, assistant director of Buck & Hickman, Limited, iron and steel stockholders and toolmakers, etc., of London, E.1, who is now aged 76, has completed 60 years' association with the tool trade.

Mr. B. B. GREEN, assistant sales manager at Edgar Allen & Company, Limited, steelmakers, Sheffield, and Mr. W. J. MCBRIDE, general manager of the engineering department, have been appointed directors of the firm.

Dr. CHARLES SYKES, managing director of Thomas Firth & John Brown, Limited, steel manufacturers, Atlas Works, Sheffield, has been presented with the honorary degree of Doctor of Metallurgy of Sheffield University.

Mr. CHARLES BAYLY, a specialist in rocket motor engineering and a former senior executive at Woomera, Australia, is joining the armament division of Sir W. G. Armstrong Whitworth (Aircraft), Limited, in a senior position next month.

Mr. G. G. GOODWIN, publicity manager of Sheepbridge Engineering, Limited, Chesterfield, is leaving the company on obtaining a senior executive post concerned with market research at the Plymouth offices of Tecalemit, Limited, lubrication specialists, of Brentford (Middx).

Mr. G. R. EDWARDS, head of the design team responsible for the Viscount turbo-prop airliner, has been appointed a director of Vickers, Limited. Mr. Edwards has been managing director of the aircraft division of Vickers-Armstrongs, Limited. Aged 46, he joined that company at Weybridge in 1935.

In order to leave Mr. A. J. MARTIN, assistant secretary of Stewarts and Lloyds, Limited, freer to attend to various duties in the Corby area and at Bilston, and to carry out other work, his position as general manager of the Central Iron and Steel Works office has been assumed by Mr. A. STIRLING.

Mr. W. J. M. TEGART, an Australian who is at present with the Council of Scientific and Industrial Research Organization in Melbourne, has been appointed Research Fellow in Metallurgy at Sheffield University. Mr. A. G. RAPER has been appointed demonstrator in fuel technology at the University.

LIEUT.-COL. H. B. RIGALL, managing director of Ruston & Hornsby, Limited, engineers, Lincoln, welcomed a civic party from Tours, France, when they inspected the works on June 14. Mr. TRIBUT, Mayor of Tours, spoke of the French appreciation of the welcome and the pleasure he had experienced in viewing the works.

The appointment is announced of Mr. HOWARD GEORGE KENNEDY as secretary of Beyer, Peacock & Company, Limited, locomotive engineers, foundrymen, etc., of Gorton, Manchester. Mr. Kennedy succeeds Mr. LESLIE THORNLEY DAWES, who has been secretary for 21 years. Mr. Dawes has resigned in view of his increasing responsibilities as a director and commercial manager of the company.

Mr. SIDNEY H. IRELAND has been appointed general works manager of the Small Heath group of the BSA Company, Limited, on the retirement of Mr. J. A. T. DICKINSON. Mr. HERBERT HOPWOOD, chief designer, BSA Motor Cycles, Limited, for the past six years, has been appointed chief engineer of the Birmingham works, in succession to Mr. H. FAULKNER. Mr. Faulkner, who has reached retiring age, will continue to serve the company for another year.

EDWIN DANKS & COMPANY (OLDBURY), LIMITED, announce the retirement of Mr. R. C. NASH. Mr. Nash joined Babcock & Wilcox in 1910 and transferred to Edwin Danks in 1924 to take charge of the estimating department. He was appointed chief assistant to Mr. J. Smith, the managing director, in 1943, and has served in that capacity until the present, when ill-health has forced him to cease active participation in the affairs of the company. His services will, however, be available for special duties.

Mr. HEBDEN HUMPHREYS, 59-year-old ambulance officer at Newton Chambers & Company, Limited, engineers, Thorncliffe Works, Chapeltown, near Sheffield, is to be made a Serving Brother of the Venerable Order of the Hospital of St. John of Jerusalem—one of the highest distinctions in ambulance work. Mr. Humphreys' admission to the Order has been sanctioned by the Queen, and he will attend an investiture. He has been with the company for 38 years, and is in charge of the firm's ambulance room. It was not until he was trapped with a severely injured colleague in Tankersley pit that he decided to concentrate on ambulance work. He attended evening classes and later organized first-aid classes at High Green and Furnace Hill.

## Obituary

Mr. FREEMAN PAGET, head of Smith & Paget, Limited, laundry and agricultural machinery makers, of Keighley (Yorks), has died at the age of 69.

Mr. HENRY GRINDALL, formerly secretary of the Metropolitan-Cammell Carriage & Wagon Company, Limited, Birmingham, died on June 17, at the age of 68.

Brig. P. W. T. H. WORTHAM, formerly Deputy Director of Ordnance Services at the War Office, has died at the age of 81. He retired in 1931, but from 1939 to 1946 was a chief progress officer in the Ministry of Supply.

Dr. JAMES MORISON MACAULAY, who has died at the age of 66, retired as senior lecturer in the natural philosophy department of the Royal Technical College, Glasgow, in 1953. At one time he was an assistant in the engineering department and had carried out research on friction and polishing of surfaces.

## Company News

KEITH BLACKMAN, LIMITED, ventilation and heating manufacturers, etc., of London, N.17—Profit before tax for the year to March 31, 1955, amounted to £262,347, against £276,866 in the previous year. A dividend of 15 per cent. is being paid, compared with 12½ per cent.

F. H. LLOYD & COMPANY, LIMITED, steelfounders, etc., of Wednesbury (Staffs)—A proposed free scrip issue of 750,000 £1 ordinary shares on a one-for-one basis is announced. The final dividend for the year to March 31 is being raised from 15 per cent. in 1953-54 to 20 per cent., following a repeated 5 per cent. interim dividend.

HEAD, WRIGHTSON & COMPANY, LIMITED—Steady and continuous progress is reported by Mr. Richard Miles, chairman, in his review of the full accounts for the year to January 31, 1955. Order-books are fuller than at a corresponding period in any year, and it is contemplated, as resources permit, increasing the programme of expenditure on equipment.

RUSTON & HORNSBY, LIMITED, engineers and ironfounders, of Lincoln—Group profits were little changed at £2,776,794 in the year to March 31, 1955, and the dividend on the £4,100,000 ordinary capital is maintained at 12½ per cent., less tax. Subject to Treasury consent, it is proposed to capitalize £2,050,000 of reserve by way of a one-for-two scrip issue in ordinary shares.

WHESSOE, LIMITED, gas-plant engineers, etc., of Darlington—The directors recommend a final dividend of 15 per cent., less tax, on the £1,000,000 ordinary capital as increased by a two-for-three scrip issue, for the year to March 31. An unchanged interim of 5 per cent. has already been paid on the former capital. For the previous year, a total of 30 per cent. included a 10 per cent. bonus.

GREENWOOD & BATLEY, LIMITED, electrical and mechanical engineers, ironfounders, and machine-tool makers, of Leeds—A final ordinary dividend of 12½ per cent. is recommended, making 17½ per cent. (the same as in the previous year) for the year to March 31, 1955. A capital dividend of 4 per cent., against nil last year, will be paid. Profit amounted to £93,114, compared with £82,082 in the previous year.

ALLIED IRONFOUNDERS, LIMITED—An effective increase of 2½ per cent. in the total dividend is announced in the preliminary statement for the year ended March 31. The directors recommend a final payment of 8¾ per cent., making a total of 13¾ per cent. on the £4,875,918 ordinary capital. This compares with the equivalent of 11¼ per cent. for 1953-54, when 22½ per cent. was paid before the 100 per cent. scrip issue.

SPECIALLOID, LIMITED, metallurgists, piston makers, of London, N.12—The year to April 2 saw the eradication of accumulated group losses and a continuation of the improving financial position. For the first two months of the current year production has been maintained at the higher level of the last half of 1954-55, and the order-book, including an increase in export orders, is substantially stronger than at the same time 12 months ago. These satisfactory results, says Mr. D. I. Ball, chairman, have been achieved in the face of persistent increases in all production costs over the previous year's level.

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# CLASSIFIED ADVERTISEMENTS

**PREPAID RATES:** Twenty words for 5s. (minimum charge) and 2d. per word thereafter. Box Number 2s. extra (including postage of replies).

**Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, John Adam House, 17/19, John Adam Street, Adelphi, London, W.C.2. If received by first post Tuesday advertisements can normally be accommodated in the following Thursday's issue.**

## SITUATIONS WANTED

HEAD FOUNDRY FOREMAN (age 43), M.I.B.F., seeks position of representative. Willing to be trained if possible. London Area preferred. Box HF342, FOUNDRY TRADE JOURNAL.

INVESTMENT Casting: MANAGER desires post, U.K. or overseas. Age 52, health perfect, with a life experience of all stages of production. Multilingual. Box IC310, FOUNDRY TRADE JOURNAL.

FOUNDRY EXECUTIVE, age 36, requires position as FOUNDRY or GENERAL MANAGER. Widely practised in organisational and technical aspects of scientific management by planning, methods engineering, motion and time study, standard costing. Experienced in handling large staff and shop personnel, and all commercial problems of founding business. Box FE341, FOUNDRY TRADE JOURNAL.

EXPERIENCED FOUNDRY MANAGER / FOREMAN (45), M.I.B.F., life experience Grey, Malleable, Non-ferrous, now Wales, desires position Midlands. Housing appreciated.—Box EF354, FOUNDRY TRADE JOURNAL.

## SITUATIONS VACANT

***The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.***

**SUFFOLK IRON FOUNDRY (1920) LTD. STOWMARKET, SUFFOLK.**

A STAFF vacancy exists for the position of FOREMAN in the Vitreous Enamelling Shop. The position calls for a progressive and conscientious man, capable of controlling mixed labour and with a good knowledge of the latest V.E. techniques. Good remuneration with Staff Pension and Life Assurance Scheme.

SOUTH AFRICAN Foundry Equipment Company requires for Johannesburg a GENERAL MANAGER, having sound knowledge of the Foundry Industry and preferably of the marketing of foundry machinery, including shell moulding equipment. A salary of not less than £1,500 and a seat on the Board would be offered a suitable man who should be less than 40. Family removal expenses would be reimbursed.—Apply in strict confidence, with full details of qualifications, past employment, present salary and personal information, to Box SA339, FOUNDRY TRADE JOURNAL.

## SITUATIONS VACANT—*contd.*

BRASS Gravity Die Casting TECHNICIAN required for a growing Foundry specialising in the production of Plumbers' Brass-ware. Applicant must have a complete knowledge of this branch of the foundry trade and be capable of organising and maintaining a high rate of production. This is a position for a very energetic and determined personality. Age not exceeding 40. Salary in accordance with experience. Contributory pension scheme. Southern area.—Box BG326, FOUNDRY TRADE JOURNAL.

REQUIRED by K. T. Steel Industries Limited, of Bombay, a man capable of making good mild steel from 100 per cent. steel charges in the cupola using the converter process. Write in the first instance, care of EDITORIAL DEPARTMENT, FOUNDRY TRADE JOURNAL, giving details of experience.

MANAGER required for up-to-date Non-ferrous Foundry producing high-class work in all alloys, including Monel, Aluminium Bronze and Aluminium. Must have good experience quantity production light castings on Moulding Machines. Salary secondary to ability, every chance given to advance in status with growing firm. House can be made available in good district if required.—Box MR328, FOUNDRY TRADE JOURNAL.

EXPERIENCED SENIOR FOREMAN required for steel and non-ferrous foundry situated in North Midlands area. There are good prospects for a suitable candidate and assistance with housing accommodation would be available if required. Box ES335, FOUNDRY TRADE JOURNAL.

CATTON & COMPANY, LIMITED, of Leeds, required a YOUNG MAN (National Service obligations completed) as ASSISTANT in their Methods Department. Ability to read casting drawings essential, foundry experience and a good level of education is desirable. This is an excellent opportunity for a young technician to broaden his experience in the carbon and alloy steel casting fields and has good future possibilities. Replies, stating details of education and experience, to CATTON & CO., LTD., 29, Chadwick Street, Leeds, 10.

MOULDERS required, non-ferrous. High rates of pay for competent men. —Apply RYCROFT & CO., LTD., Westcroft Foundry, Great Horton, Bradford.

METAL PATTERN SHOP FOREMAN required by modern Iron Foundry on South-East Coast, marketing its own finished products, to gradually take over and further develop shop producing precision metal patterns for quantity production. Applicants must have wide experience in shop attached to Foundry. Those interested in this opportunity should write in confidence, giving all relative particulars and present salary.—Box MP349, FOUNDRY TRADE JOURNAL.

## SITUATIONS VACANT—*contd.*

SOUTH AFRICA. — Company Engineers and Merchants, established in the Union more than 50 years, with offices and warehouses in main centres and works near Johannesburg, wishes to co-operate with overseas concern ready to manufacture product in whole or in part in the Union. Meehanite Foundry (Mechanised and Floor) and Machine Shop capacity available. Distribution through warehouses for consideration.
Reply Box 104, c/o WALTER JUDD, LTD., 47, Gresham Street, E.C.2.

ALUMINIUM FOUNDERS, old-established firm in the Birmingham area, have the following vacancies:—
DRAUGHTSMAN, experienced in the designing and detailing of Gravity and Pressure Dies.
FOREMAN for Pressure Die Casting Dept., with up-to-date knowledge of production on Reed Prentice, Polak and E.M.B. machines.
FOREMAN to take charge of small Sand Foundry doing jobbing work, having sound technical knowledge and administrative ability.
Apply, in confidence, giving full details and remuneration required, to Box AF360, FOUNDRY TRADE JOURNAL.

MOULDERS required for North Wales Foundry. Must be used to casting up to 3 tons. Apply for further details to Box MR361, FOUNDRY TRADE JOURNAL.

**TEXTILE MACHINERY MAKERS LTD., require**

**GENERAL MANAGER**

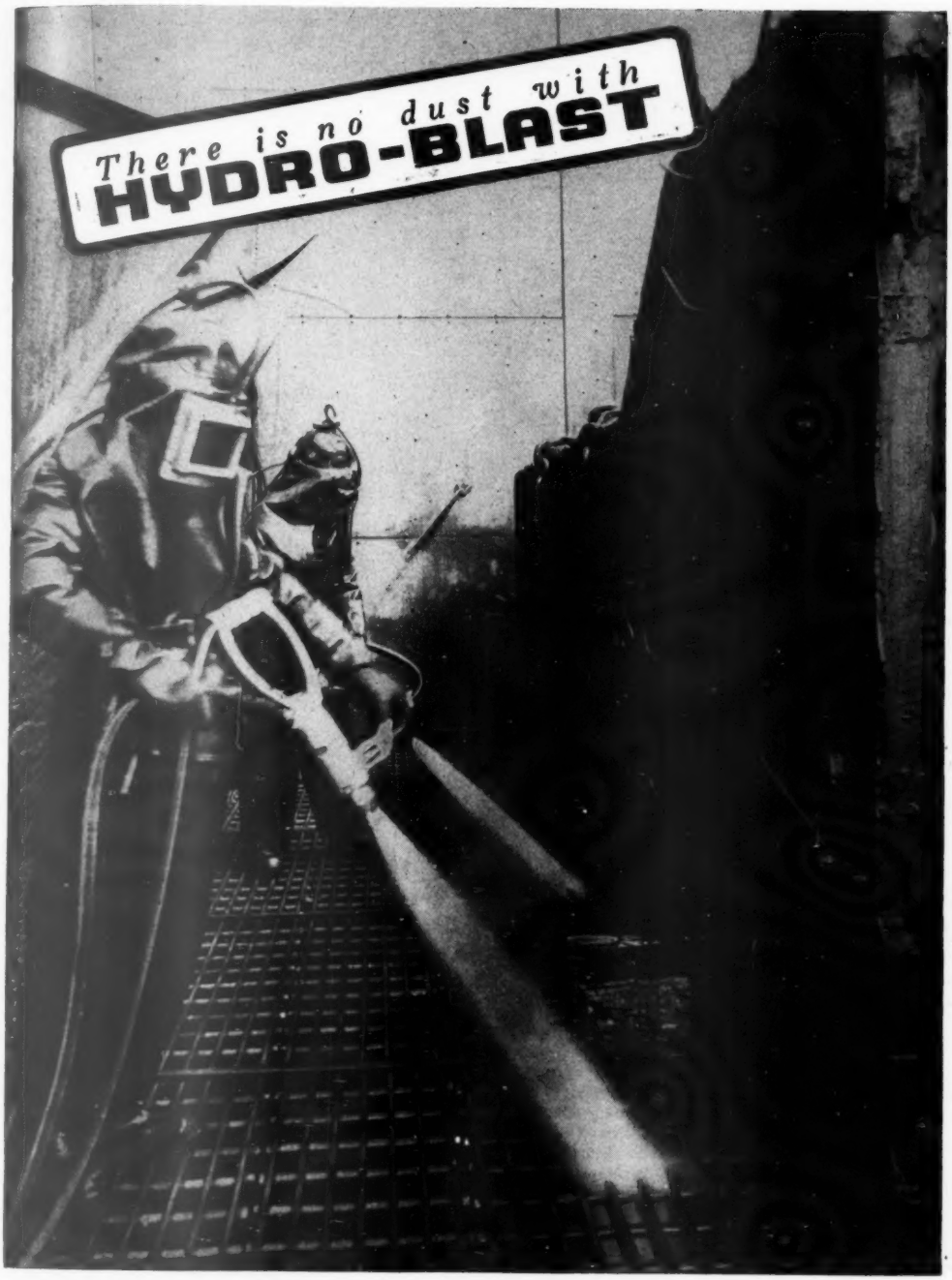
**for their subsidiary company PLATTS (BARTON) LTD., URMSTON, MANCHESTER**

A man of outstanding calibre and record, with strong engineering qualifications and good knowledge of modern foundry practice is required. He will preferably have an engineering degree and must have had successful experience in large scale management and administration.
The salary and generous non-contributory pension and life insurance arrangements will fully recognise the considerable responsibility of the post, which affords ample opportunities for further advancement.
Applications in strict confidence should be addressed to:-

**THE MANAGING DIRECTOR, TEXTILE MACHINERY MAKERS LTD., HARTFORD WORKS, OLDHAM**

marked "General Manager".

They should give age, full details of experience and names of referees who will only be approached by agreement.

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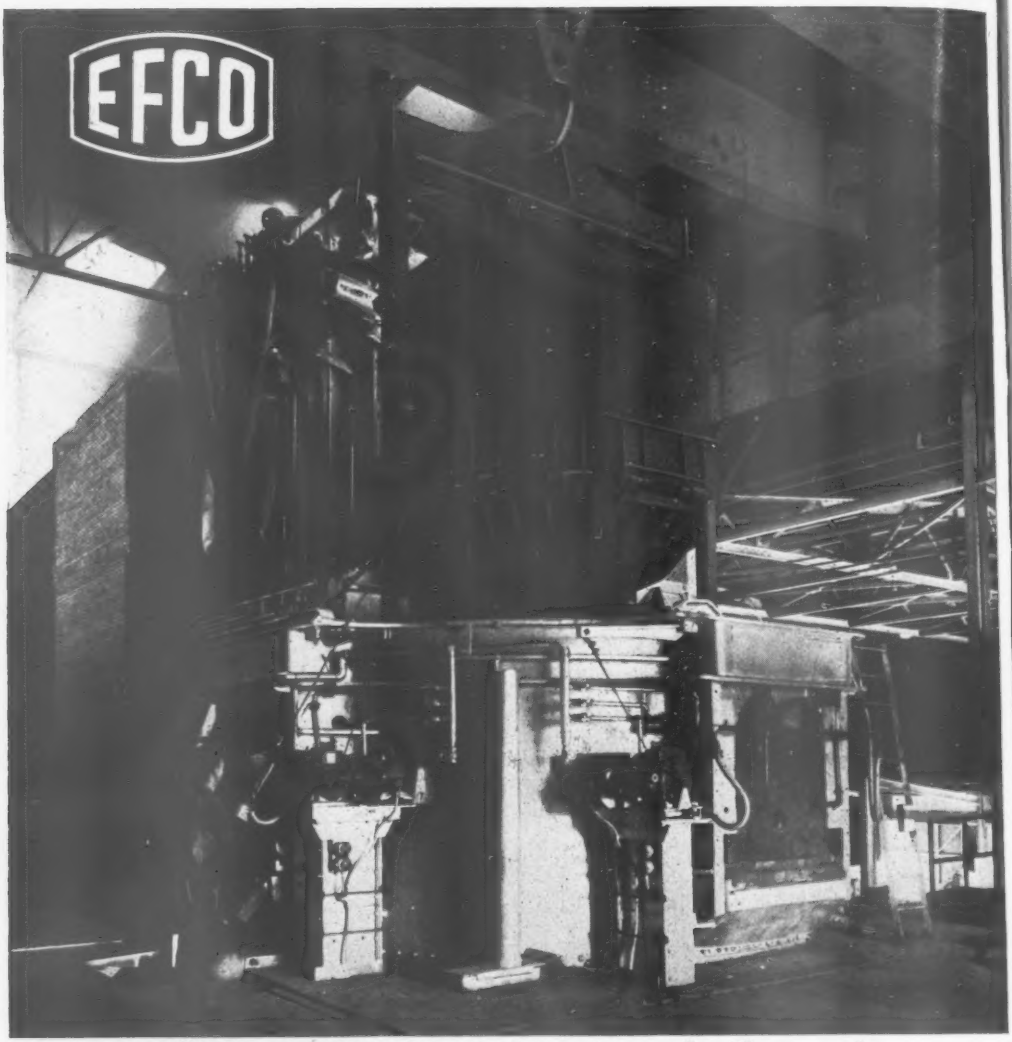


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Arc Furnaces have already replaced open hearth furnaces and converter plant in the steel foundry. Large Arc Furnaces can now compete economically in the production of tonnage steel normally produced in open hearth furnaces. The photograph above shows a Swing Roof 80-ton Furnace about to be charged.

EFCO Arc Furnaces incorporate the designs of Swindell Dressler Corporation, one of the world's largest manufacturers of these furnaces.

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*TELEPHONE WEYBRIDGE 3091 (ASSOCIATED COMPANIES: ELECTRIC RESISTANCE FURNACE COMPANY LIMITED ELECTRO-CHEMICAL ENGINEERING COMPANY LIMITED)*

P3078

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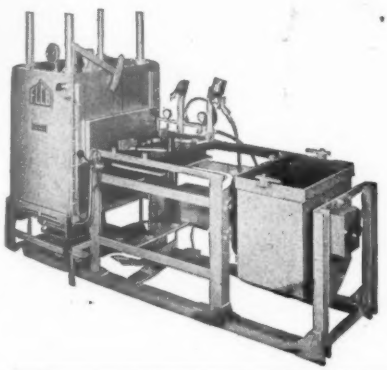
The Shelmolda 'Duplus' is low in first cost, economical to operate and costs little to maintain. Its design is simple and straightforward, yet it has the advantages of more complicated and costly apparatus. Operation is semi-automatic, with all the strenuous work carried out mechanically. The patent oven is thermostatically controlled and gives the machine a proved capacity of 50/60 moulds per hour. Pattern plates measure 24in. by 16in. and the maximum depth of pattern is 5in. Floor space required is 8ft. 6in. by 3ft. 3in. and the machine is operated by one man. Delivery is 8 to 10 weeks.



Shelmolda

DUPLUS

PATENT APPLIED FOR

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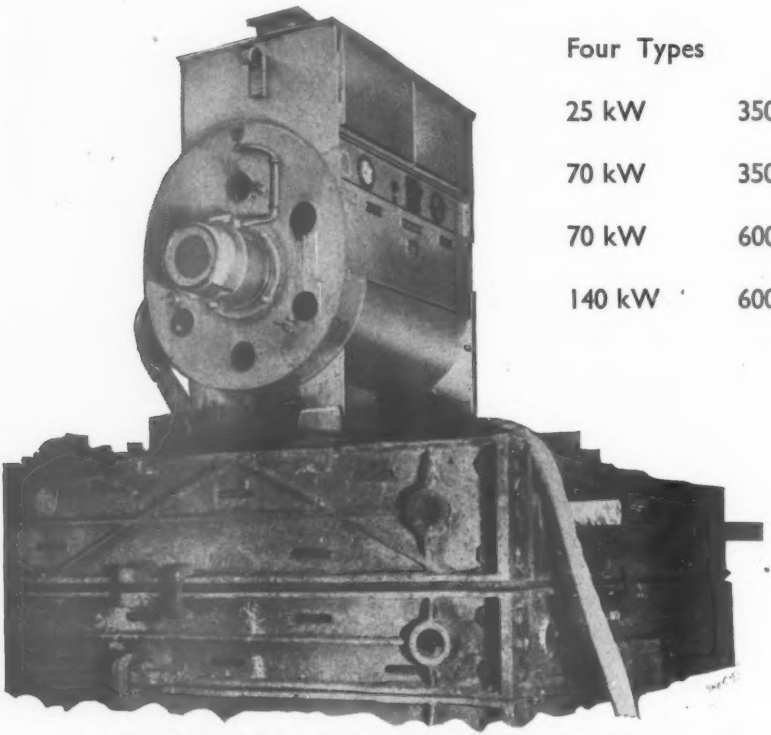
For all types of Sand Moulds

Deliver Clean Hot Air at Preset Temperature

Full Automatic Temperature Control

Save Time Labour and Power



Four Types

| | |
|---|---|
| 25 kW | 350°C Max. |
| 70 kW | 350°C Max. |
| 70 kW | 600°C Max. |
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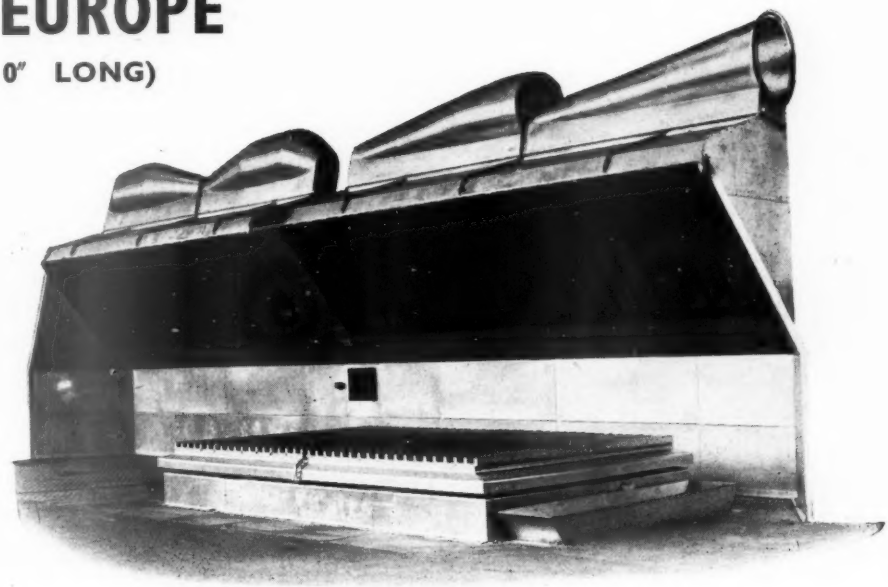
# THE LARGEST KNOCK-OUT HOOD IN EUROPE

(45' 0" LONG)



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*Send for leaflets DFR953 and FR753 dealing with other aspects of dust and fume removal from both ferrous and non-ferrous foundries.*

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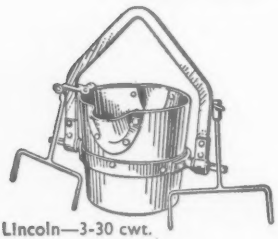
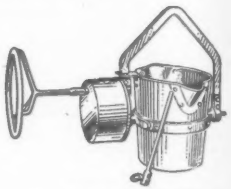
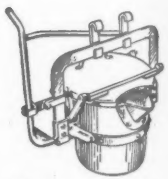
# Aron Foundry Equipment



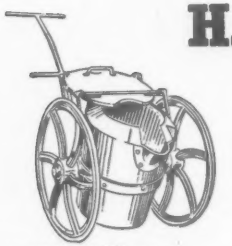
Lincoln—3-30 cwt.



Somerset—3 - 25 cwt.



Windsor—1 - 10 cwt.



Lancaster—3-15 cwt.

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NATIONAL SHED

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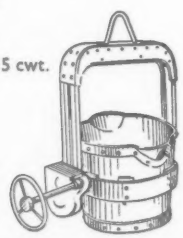
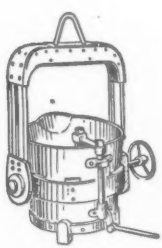
Motorised or Belt Driven.

Rutland—S.W.L. 15 cwt.



Devon— 10 cwt. - 25 ton.



Devon with Articulated Arm, Bottom Pour. 5 cwt.-25 ton.

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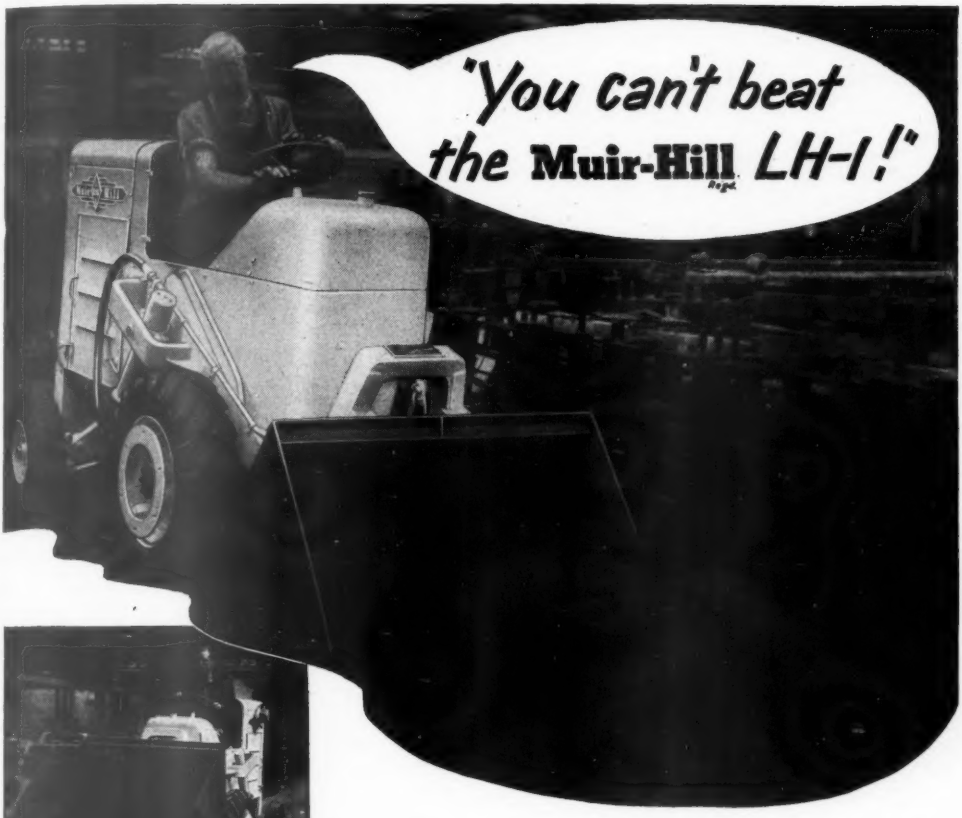

*With only 4ft. 3in. width and 7ft. 6in. turning radius, working in confined spaces presents no difficulties.*

*The LH-1 is ideal for handling coke, limestone and miscellaneous rubbish—and the 5ft. 8in. tipping height brings lorry loading within the range of this versatile machine.*

More and more foundries are finding that the Muir-Hill LH-1 Hydraulic Loader is the fast, economical answer to all bulk handling problems. With its 1,200 lbs. load rating, 10·5 cu. ft. bucket and 5ft. 8in. tipping height, this small and highly mobile lifting and carrying machine mechanises the handling of sand, small hot castings, scrap, coke, raw materials, etc., bringing power loading to bear in closely confined or restricted areas. Powered by a compact diesel engine and with sensitive hydraulic control of bucket and beam, the LH-1 means the end of wasteful, laborious bulk handling methods in foundries.

**The Muir-Hill LH-1 HYDRAULIC LOADER**

★ *Dozing methods of cleaning up foundry sand emptied from moulding boxes tend to pack the sand, trapping undesirable steam and moisture. However, the lifting and discharging action of the LH-1 has the opposite effect, aerating the sand as it heaps it in readiness for the next filling of the boxes.*

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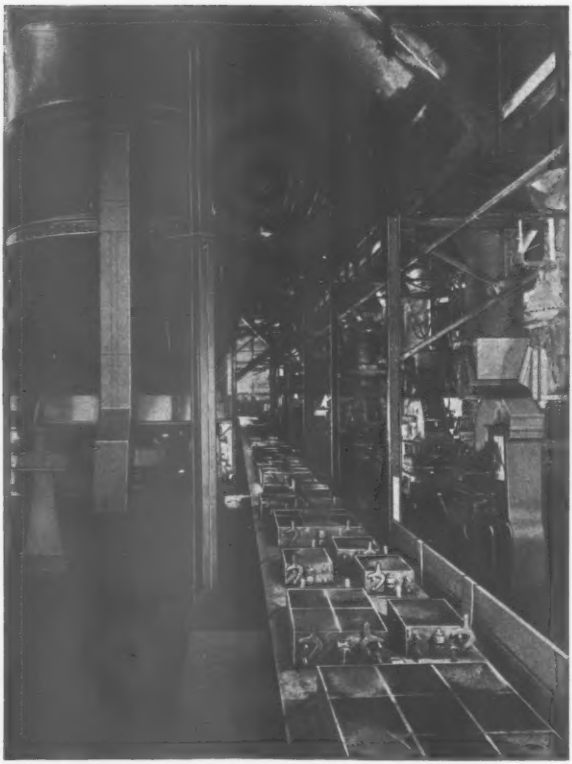

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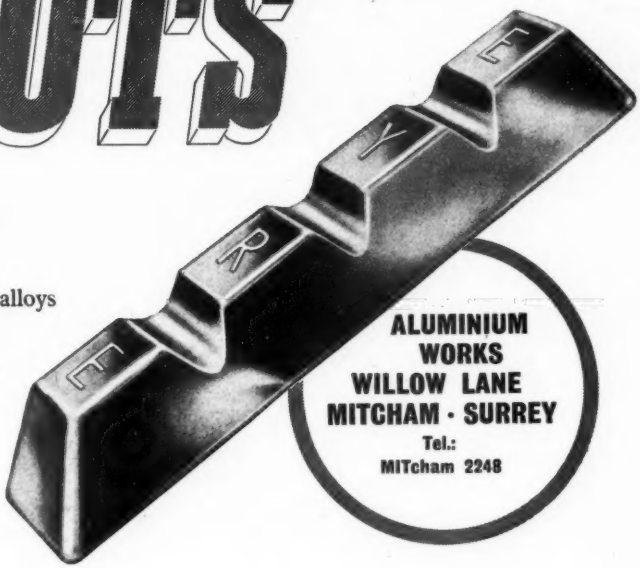


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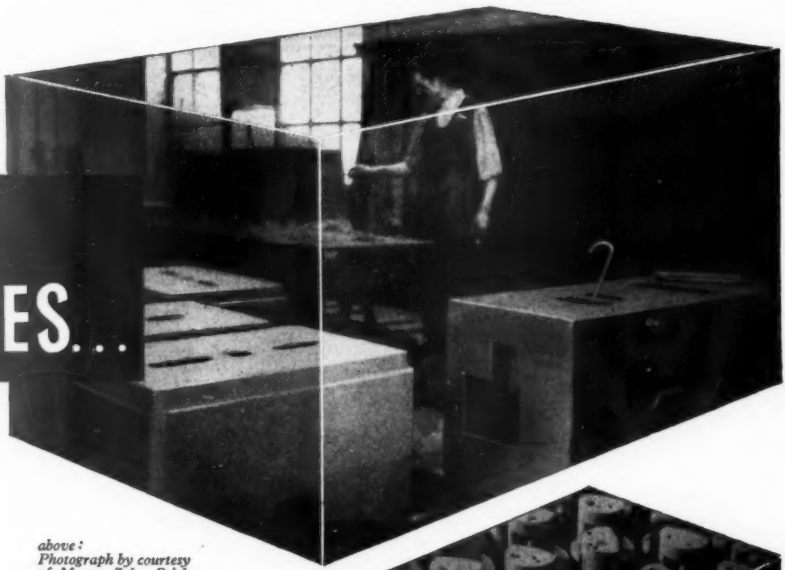

*above:*
*Photograph by courtesy of Messrs. John Stirk & Sons, Ltd., Halifax.*

*below:*
*Photograph by courtesy of Dupont Foundries Ltd., Dudley Port, Tipton, Staffs.*

# ...or small

Whether you require small cores on a large scale quantity production or a small run of special cores for a 20 ton casting, you can rely on Spermolin Core Oils and Binders for consistent accuracy. We invite you to consult us about your own special requirements and problems.

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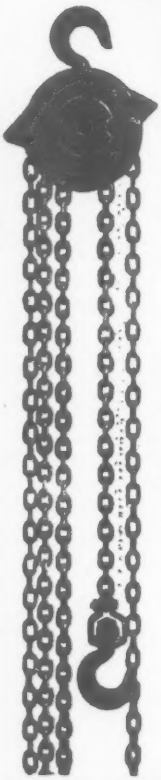
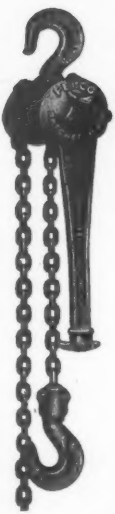


### TRIPLE GEAR CHAIN BLOCKS

Single, Double and Multiple Purchase with capacities from ½ to 10 tons.



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Incorporating a patented Overload Preventer giving greater security and safety to the operator, also reducing wear and saving cost of repairs and maintenance. There is a free-wheeling feature enabling quick adjustment of unloaded chains.

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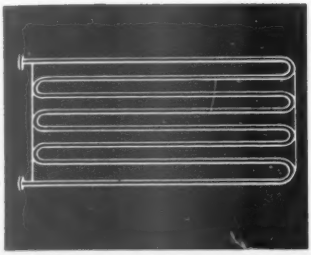

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"Brightrad" panels offer an efficient and economical method of regulated heating for the jobbing foundry, pattern shops, etc. They can be installed in sections thus giving "local heat" as required.

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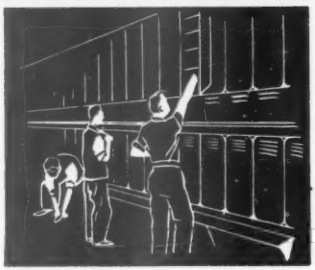

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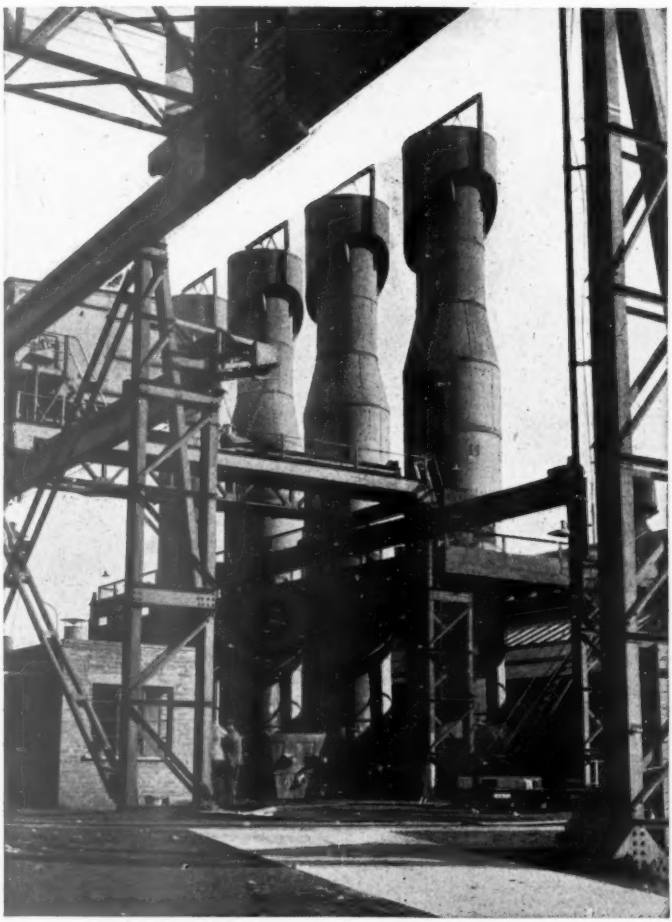

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**Our Contract also included Four similar Cupolas to the above each of 8 tons per hour capacity for EIGHT hours Continuous Melting all Mechanically Charged and complete with Blowers, etc.**

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**We are also Makers of Steel Converters, Crucible and Non-crucible Furnaces, Ladles, Rumblers, Pig Iron Breakers, etc.**

T13

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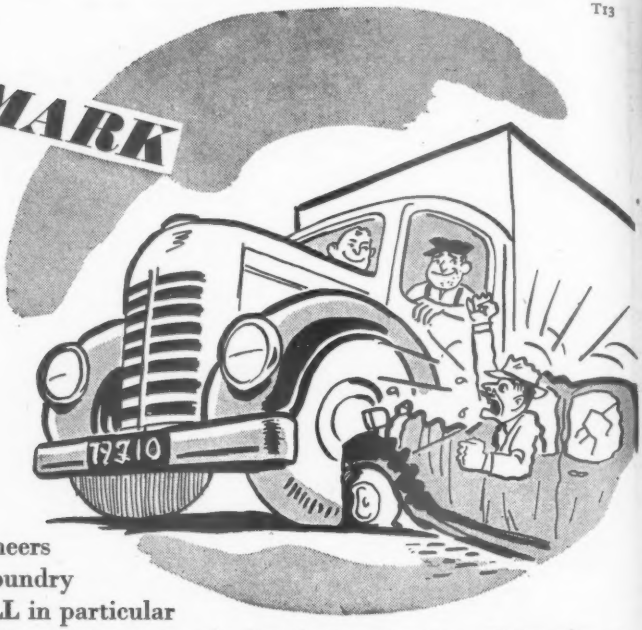


Amongst the early pioneers of the use of resins in the Foundry Industry, **LEICESTER, LOVELL** in particular have maintained their pioneering spirit, not only by the production of improved binders for conventional solid cores but also by developing wider uses of resins in foundry work.* In the pioneering of these, as well as in originating (and developing, in conjunction with Feslente Ltd.) the F.E.L.L. pre-coated sand process, **LEICESTER, LOVELL** have indeed made their mark; their mark is **THOR.**

* . . . *for conventional shell moulding as well as for pre-coated sand.*

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. . . *for wooden patterns, CASCOREZ Glue provides pattern makers with a ready-to-use adhesive which is clean, remarkably quick setting and has unlimited "pot life".*

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. . . *for cast plastic patterns and core boxes. EPOPHEN epoxide resin is at present undergoing extensive field trials for the production of light, dimensionally stable patterns and boxes which require no finishing.*

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*Manufactured in Gt. Britain by*

**LEICESTER, LOVELL & COMPANY LIMITED**

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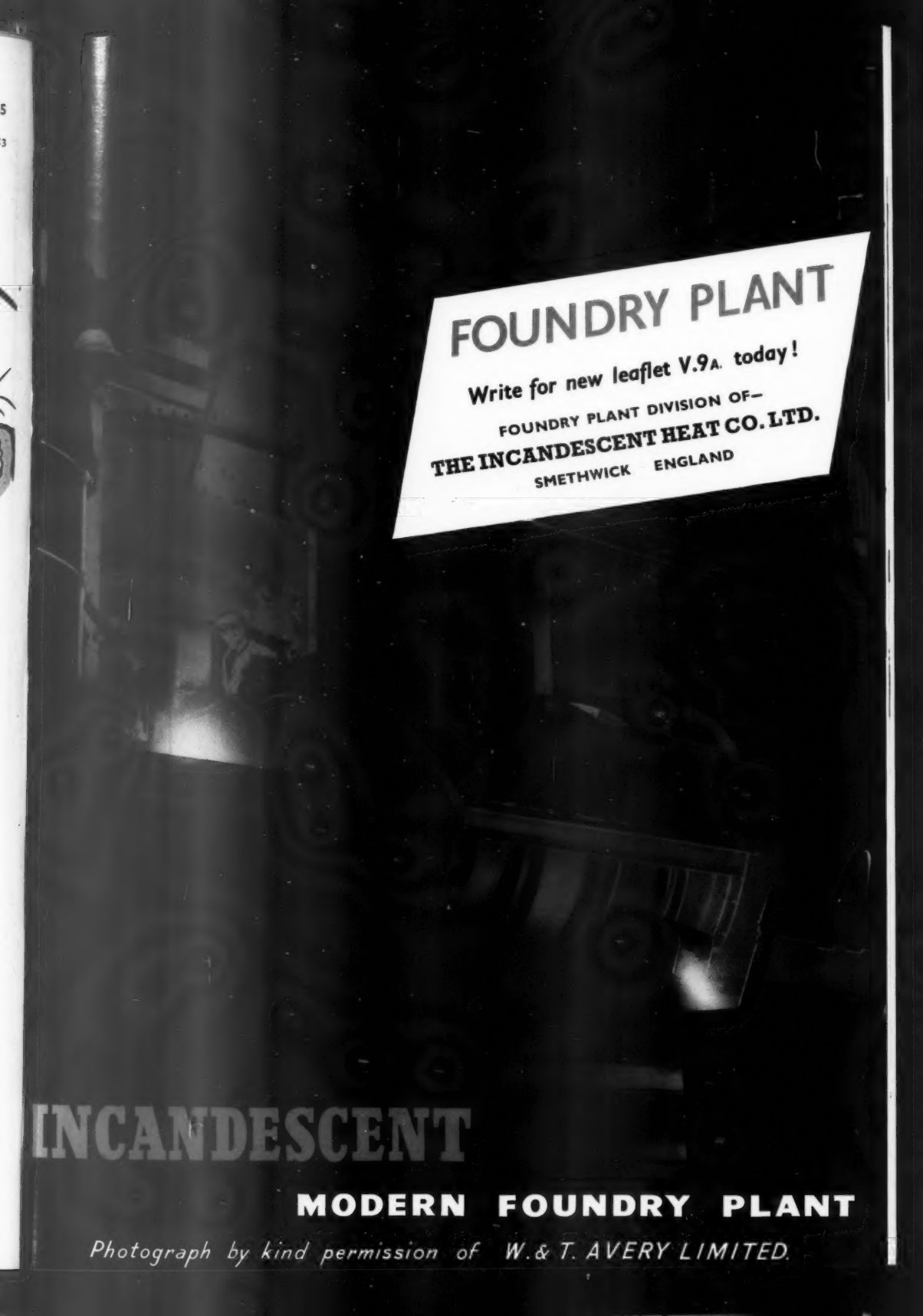
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"New Process" Refined Iron

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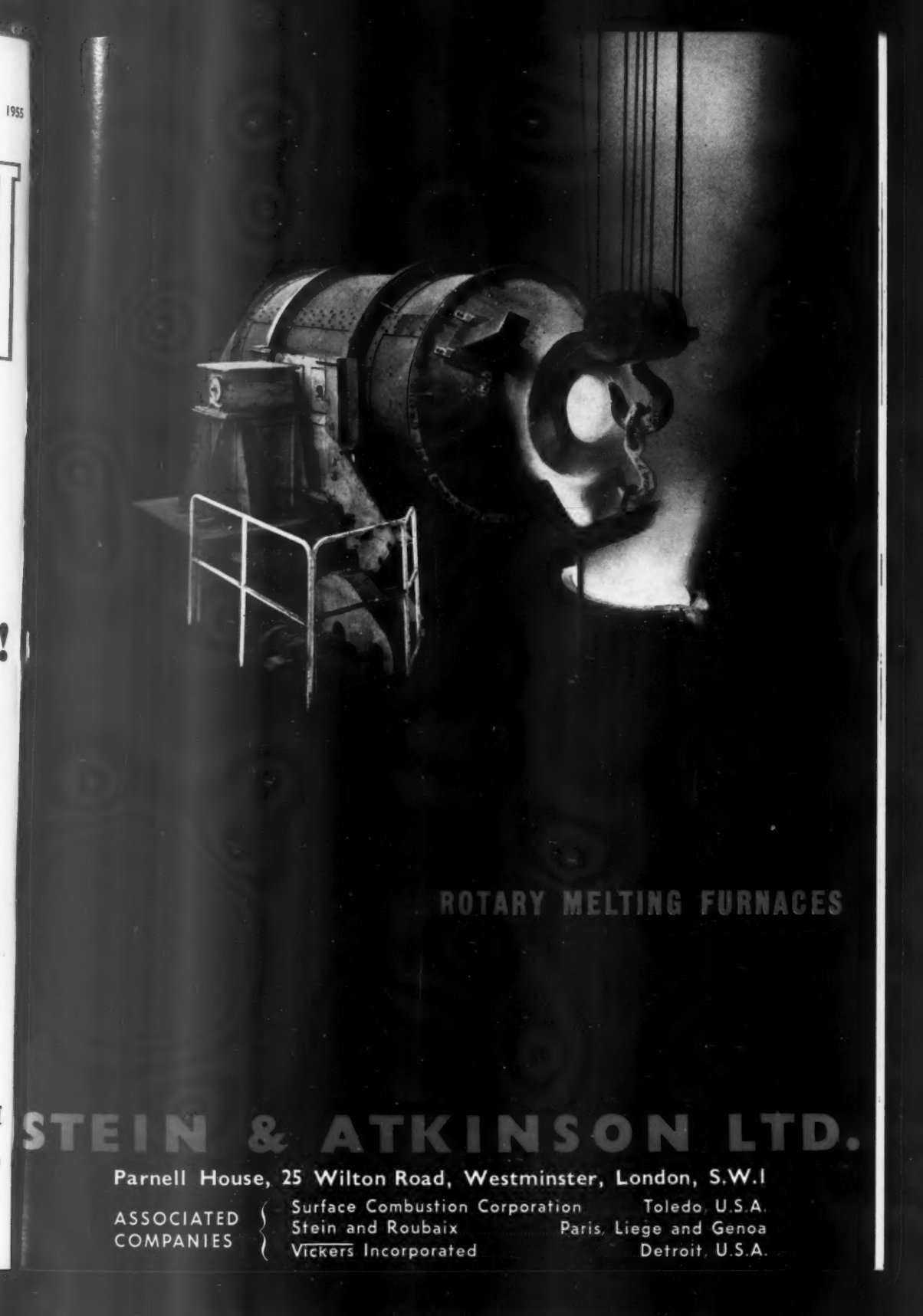
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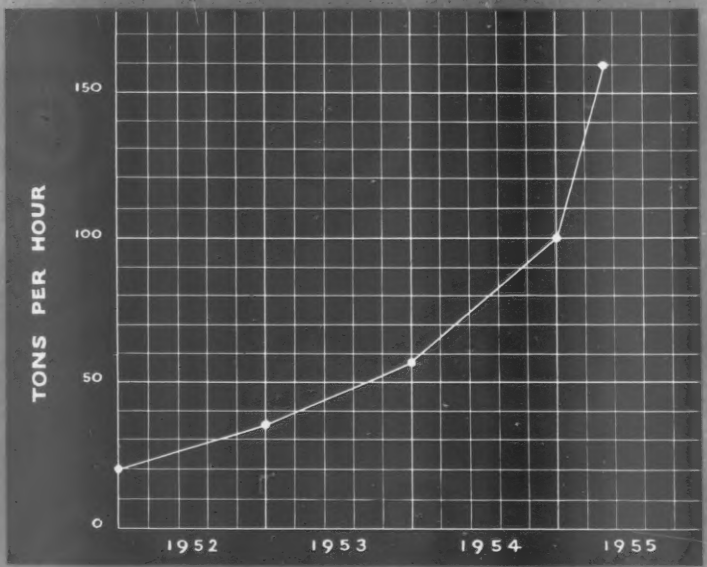


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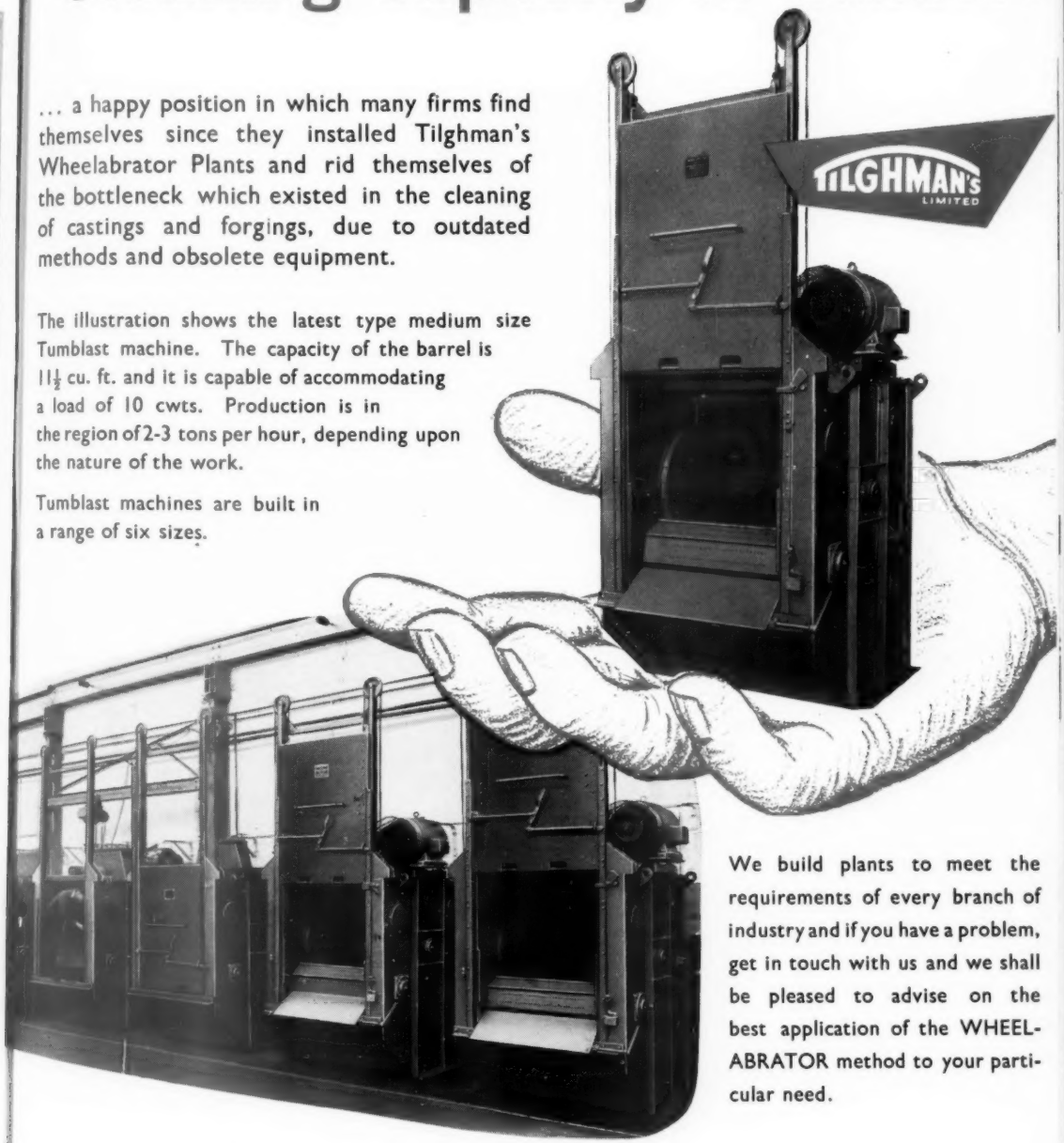


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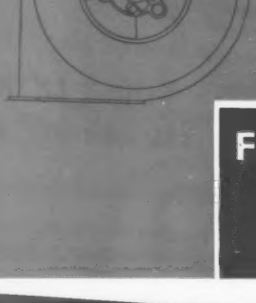
PORTABLE

TRACTOR

MOUNTED

Stationary Type Sandslinger with Arm raising and lowering gear



FP&M LTD

**A sturdy, flexible and reliable unit**

**Foundry Plant & Machinery Ltd**

EGLINTON ENGINE WORKS
120 TRADESTON STREET
GLASGOW, C.5

# *Confidence and Accuracy...*

In Switzerland, during the middle ages, William Tell, so the legend goes, was forced to shoot an apple off his son's head as a punishment for an offence committed against an Austrian officer. He later killed this officer, and helped his countrymen to throw off the Austrian yoke. William Tell's son, the legend tells us, was not afraid to face the ordeal; he was confident of his father's accuracy. You, too, in a less dramatic fashion, can be confident that Darwen Brand (Regd.) pig iron will meet your requirements accurately.

*"Darwen Brand"*

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# REFINED PIG IRON

**REFINED IRON CO. (DARWEN) LTD** · **LEESTONE ROAD** · **WYTHENSHAWE** · **MANCHESTER**

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S&B9

'FULBOND' IN THE FOUNDRY 'FULBOND' IN THE FOUNDRY 'FULBOND' IN THE FOUNDRY

# 'FULBOND'

## SAVES SAND, TIME & COST

**'Fulbond'**
**strengthens natural sands,**
**bonds synthetic moulding sands**
**and gives green strength to cores.**
**May we recommend the**
**best grade for your practice?**

★*Our technical service department will be pleased to give details of the various grades of 'Fulbond' available. You are also invited to send us your sand to test.*

**THE FULLERS' EARTH UNION LTD.**

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Telephone: REDHILL 3521

# Refractories for foundries? Don't ask me, ask the expert!

On a subject so complex as modern refractories, a second opinion is sometimes more than advisable; it might almost be called essential. It is true that for the simplest low temperature applications, 'firebrick' may still be a good enough specification. But the choice of the refractories for a modern furnace with a high output is undoubtedly a specialist's job.

Morgans are such specialists. What's more, specialists who are ready to share their knowledge. As designers and operators of the most up-to-date refractories plant in Europe, making everything from the finest quality refractory bricks to specialised pure oxide ware, they know what they are talking about. Their advice is completely unbiased and well worth having. And it is yours for the asking.

MORGAN Refractories

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*For further information, please write to:—*

MORGAN REFRACTORIES LTD., NESTON, WIRRAL, CHESHIRE. TEL: NESTON 1406 . NE10a

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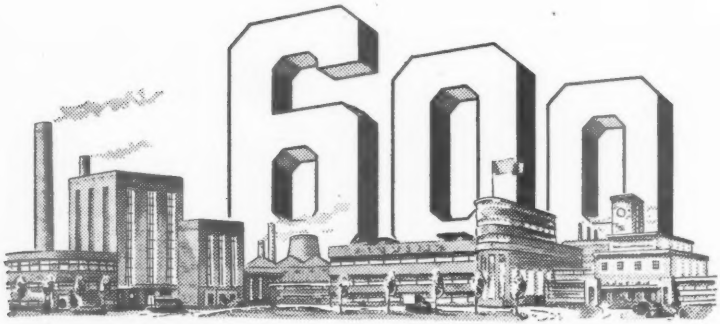


# Part of the industrial landscape

We and our Associated Companies have a history of 121 years of service to all manner of different industries. Among our activities we dismantle and remove obsolete plant and industrial structures; we collect, and send to the ever-hungry steelworks, great quantities of Scrap Iron and Steel; we supply the building industry with equipment and tools, and keep many concerns, large and small, up to date with mechanical handling equipment of the latest types. We supply industry with a vast range of new machinery, as well as modern reconditioned plant of virtually every kind—and deliver *promptly* from the largest stocks in the country. In short, we are fully equipped to serve many branches of industry and our experience is unrivalled in our own field.

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**GEORGE COHEN**

**SONS AND COMPANY LIMITED**

*Established 1834*

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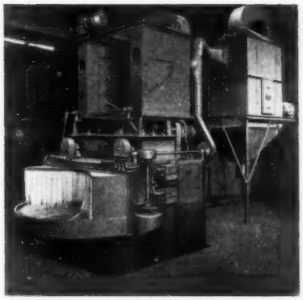
**The 600 Group Information Department is located at Wood Lane, London, W.12**
**Telephone: Shepherds Bush 2070. Telegrams: Omniplant, Telex, London**

FTJ/55/3/GS

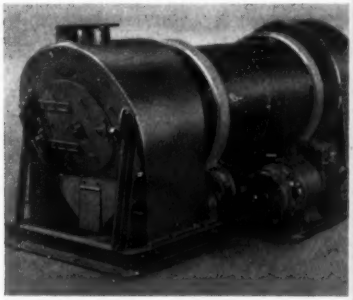
# TITAN Foundry Plant

**Is designed by specialists to meet the requirements of all classes of Foundries from the smallest to the largest. The illustrations show only a small part of our range of equipment, our Representatives at Home and Overseas will gladly supply further information.**

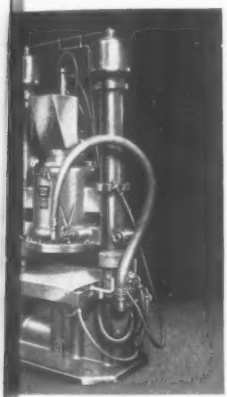
Centrifugal Casting Machines.



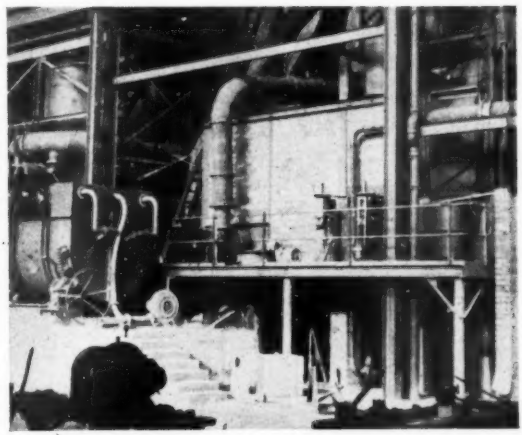
Sand Wizard Shot Blasting Machines, Table, Barrel, Continuous and Special purpose types.

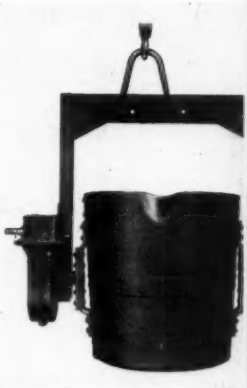


Rotary and Stationary Sand Dryers, Mixers and Mills.

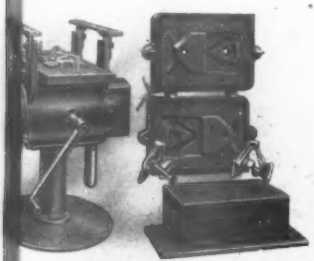


ore Blowing Machines from 2 to 250 lbs capacity.





Ladles and Receivers from 28 lbs to 15 Tons capacity.



Moulding Machines.

**The "TITAN" range of Cupolas covers capacities from 15 cwts to 20 Tons or more per hour. Includes the unique Metallurgical Blast Cupola which incorporates Hot Blast and Water Cooling. All auxilliary equipment supplied, Mechanical Chargers, Spark Arresters, Fans, and complete Stockyard Plant.**

Moulding Boxes and Snap Flasks

THE CONSTRUCTIONAL ENGINEERING CO. LTD

DESIGNERS & ACTUAL BUILDERS OF EFFICIENT FOUNDRY PLANT

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C2

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## HIGH SPEED CORE SAND MIXER

★ WITH SPECIAL ATTACHMENTS FOR BREAKING DOWN USED CORES

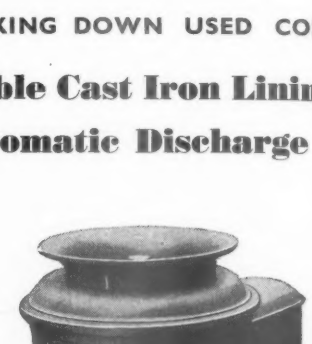
**Built For Continuous Use · Detachable Cast Iron Linings**

**Strong Sound Construction · Automatic Discharge**

**RATE OF OUTPUT PER 56 LB. CHARGE**

| | |
|---|---|
| WITH CREAM CORE BINDER | 4 mins. |
| WITH RESIN BINDER FOR SHELL MOULDING | 4 ,, |
| WITH POWDER BINDER | 5 ,, |
| WITH SEMI-SOLID BINDER | 6 ,, |

**RECLAIMING USED CORES - 3 MINUTES**



*OVER 200 MACHINES INSTALLED DURING RECENT MONTHS*

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***EXPORT ENQUIRIES INVITED***

| MODEL | MOTOR | CHARGE | | ★ WITH ATTACHMENTS | |
|---|---|---|---|---|---|
| **STANDARD** | 2 h.p., 3 p.h. | 56 lbs. | £93-10-0 | £104-10-0 | Ex-Works |
| **MAJOR** | 7½ h.p., 3 p.h. | 112 lbs. | £198-0-0 | £210-0-0 | Chipping |

**Also SEND FOR DETAILS OF THE "VORTEC" SLURRY MIXER**

***Designed and Manufactured by "Foundrymen for Foundrymen"***

**GEORGE TWEEDY & CO. LTD., CHIPPING, nr. PRESTON** CHIPPING 258/9

# "B.B.R."

## BRADLEYS BASIC REFINED

### Pig Iron

BRADLEYS BASIC REFINED is produced by a newly developed process utilising basic lined furnaces and operating with a wholly basic slag.

BASIC REFINED IRON is specially suitable for Nodular or Spheroidal Graphite Iron, Roll Making, Steel Making, Carburising Iron and all processes requiring an exceptionally pure cast iron.

- TOTAL CARBONS in "B.B.R." are normally available from 3·2% to 4·0%. In certain cases specifications for Carbons in excess of 4·0% can be met. In all cases Total Carbon contents are determined by the Volumetric combustion method utilising solid or chilled samples.
- SULPHUR contents in "B.B.R." normally range between 0·004% and 0·02% Specially low sulphurs determined within the limits of accuracy of B.S.I. Method (Specification No. 1121, Part I, 1943) can be guaranteed.
- PHOSPHORUS contents of "B.B.R." normally range from 0·04% to 0·50%. according to requirements. Specifications of less than 0·04% can be met under certain circumstances.
- SILICON and MANGANESE contents are supplied to specification. Silicons normally range from 0·20% to 3·0% and Manganese from 0·30% to 1·5%.
- RESIDUAL ELEMENTS. Control is exercised over the whole range of residual metallic elements through our Spectrographic Laboratories and Certificates of Analysis can be supplied with every consignment.

**BRADLEY & FOSTER LIMITED**
**DARLASTON IRON WORKS**
**DARLASTON · STAFFORDSHIRE**

**No: 3 in the series of METROVICK ELECTRODE Advertisements**

it's child's play!

with **Castivick '3' electrodes**

*Avail yourself of the extensive user experience and vast research facilities of the Metrovick organization. They are able to give advice on the most suitable electrode for any job.*

The effective welding of cast irons has become a much easier proposition with the introduction of cast iron with graphite in nodular (spheriodal) form, and with a low sulphur content. The new Castivick '3' electrode takes full advantage of these factors. Send for leaflet No. 787/17a.

***This is one of the wide range of Metrovick electrodes***

METROPOLITAN-VICKERS

ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

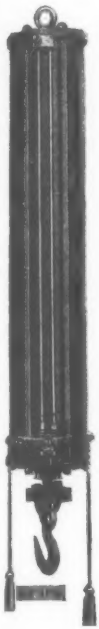
*Member of the AEI group of companies*

L/P403

# PNEUMATIC TOOLS

**AND**

FOUNDRY EQUIPMENT



FETTLING HAMMERS
FOUNDRY AIR HOISTS
FOUNDRY CONVEYOR CYLINDERS
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AIR COCKS
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DRILLING MACHINES

GLOBE PNEUMATIC EQUIPMENT WILL INCREASE PRODUCTION & REDUCE HANDLING COSTS

## THE GLOBE PNEUMATIC ENG., CO., LTD.

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Telegrams: PNEUMATOID, ROMFORD.

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# VICKERS
## PROVED PATTERNS

*Vickers Proved Pattern Service guarantees the dimensional accuracy and function of pattern equipment, dies and foundry tooling before dispatch to the customer.*

"The very rapid strides made by this Company in the technique of Shell Moulding, would have been quite impossible without the first-class Pattern service and technical assistance rendered by Messrs. John Vickers & Sons Ltd. of Darlington."

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**FERRANTI LIMITED.**

"An outstanding solution to the problem of production hold up due to casting errors."

**ARMSTRONG WHITWORTH & CO. (PNEUMATIC TOOLS) LTD.**

"A service of unquestionable value in eliminating casting trouble and delays."

**WESTOOL LIMITED.**

JOHN VICKERS & SONS LTD.
DARLINGTON Telephone Darlington 2632

# *All you need for the*

# SHELL MOULDING PROCESS

***Bakelite Limited*** have been closely associated with the development of the Shell Moulding Process and, with forty years' experience of phenolic resin production to their credit, can give you valuable assistance on this important new technique.

***Materials*** Products supplied include:
POWDERED RESINS
RESINS FOR PRE-COATED SANDS
ADHESIVES FOR SHELL ASSEMBLY
Parting Agents
Wetting Agents

***Research Service*** The Bakelite Research and Development Department is continually working to improve materials. Our experimental foundry and laboratories are specially equipped for the study of shell moulding on a practical basis and have enabled us to make significant improvements to the process.

***Information*** Bakelite engineers are available at our Sales Offices and will be pleased to advise and assist on any aspect of the process. If general information is required please ask for our illustrated booklet.

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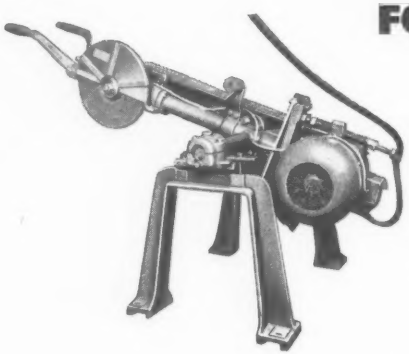
*Sales Offices: LONDON, Sloane 0898; BIRMINGHAM, Midland 5911/4; MANCHESTER, Blackfriars 5174/7; GLASGOW, City 6825*

RIOA



## FOR CUTTING-OFF MACHINES . . .

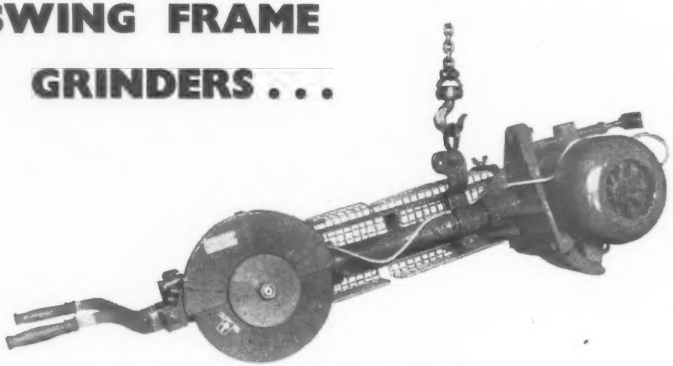
Illustrating our Cutting-Off Machine using a 16in. by ⅛in. unbreakable disc.

*THE FASTEST CUTTING-OFF MACHINE YET MADE. FOR CUTTING OFF RISERS AND RUNNERS, ROUNDS, FLATS, TUBES, BRICK AND CONCRETE, ETC.*

Capacity 2½in. diameter on steel.

SPEEDS UP TO 9,000 R.P.M.

## AND SWING FRAME GRINDERS . . .



Illustrating our No. 5 size for a 14in. by 2in. wheel. For use on any kind of fettling work.

Also to the same arrangement, this type can be supplied for "CUTTING OFF" purposes, using a 16in. by ⅛in. disc as above.

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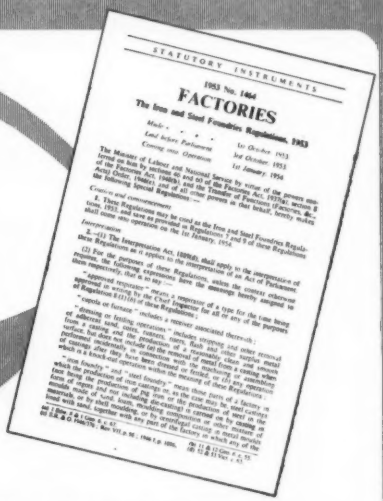
EBENEZER WORKS · MORPETH STREET . SHEFFIELD 3

Telephone: 22797 Telegrams: "WILBENT"

## for Foundry Floors and Gangways - Refractory Concrete is the Ideal Material


STATUTORY INSTRUMENTS

1953 No. 1464

FACTORIES

The Iron and Steel Foundries Regulations, 1953

Made . . .

Laid before Parliament . . 1st October 1953

Coming into Operation . . 1st October 1953
1st January 1954

The Home Office regulations say " Foundry gangways and Pouring Aisles shall have an even surface of hard material, and shall not have on them more sand than is necessary to avoid risk of flying metal from accidental spillage." The use of Refractory Concrete (made with Ciment Fondu and crushed firebricks or grog) will enable you to speedily fulfil these conditions, because Refractory Concrete:

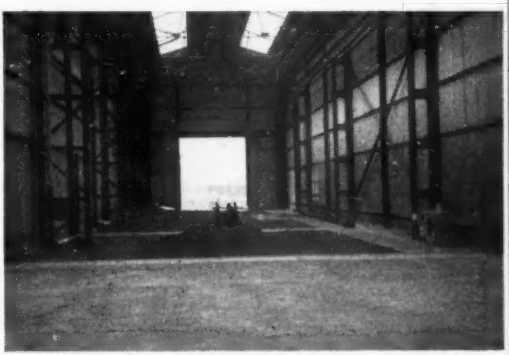
. . . has a high cold strength and is ready for full use 24 hours after placing.

. . . will withstand repeated spillages of hot metals and direct contact of hot castings without spitting and blowing.

. . . no sand covering needed.

. . . is non-spalling under widest fluctuations of temperature and highly resistant to all forms of mechanical shock.

. . . is stable under load up to 1300° C. (2400° F.)



*Photograph by courtesy of Globe Tank & Foundry (Wolverhampton) Ltd.*

**REFRACTORY CONCRETE**

*The Adaptable Refractory material made with crushed firebrick and*

CIMENT FONDU
ALUMINOUS CEMENT

**Concrete Rock-Hard within one day**

**LAFARGE ALUMINOUS CEMENT COMPANY LIMITED**

73 BROOK STREET, LONDON, W.1. TELEPHONE: MAYFAIR 8546

★ *You are invited to write for further details and photographic examples.*

AP3/1303

*One of many different types of Pattern Equipment Produced in our Works*

Each of the illustrated 1,000 lb. bomb coreboxes (Mainly of cast iron) weighed 19 cwt. nett and was engineered from start to finish in our works, including preparation of drawings, wooden masters, final machining and assembly.

*Send your Pattern-making problems to . . .*

**B. LEVY & CO. (PATTERNS) LTD.**

1-5 OSBERT STREET, WESTMINSTER, S.W.1

TELEPHONE: VICTORIA 1073 OR VICTORIA 7486

*Prompt quotations and delivery*

# Something the customers understand

Difficulties which arise when translating from one language to another are no obstacle to the customer's understanding and appreciation when a product bought in the exchanges of trade does its designed job *extremely well* and keeps on doing it, day by day, for years.

Fordath's reputation has spread beyond the shores of the United Kingdom and their products are used in many countries in every continent. The reliability for which they are renowned springs from their insistence that everything they sell is **proved in the foundry** *before* it is offered to the foundry trade

GLYCO CORE OIL COMPOUNDS

FAMOUS CORE BINDERS

*A range that covers every foundry requirement.*

**FORDATH**

PLANT & EQUIPMENT

**'New Type' Sand Mixers,**
**Core Extrusion Machines,**
**Worm-geared Roller Mills,**
**Shell Moulding Units, &c.**

**FORDATH** associate producing plants

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THE FORDATH ENGINEERING CO. LTD., HAMBLET WORKS, WEST BROMWICH, STAFFS.

TELEPHONE: *West Bromwich 0549, 0540, 1692* TELEGRAMS: *Metallical, West Bromwich*

The rapid baking QD corebinders give a quick build up of strength, which does not fall away under prolonged baking. Variations in stoving conditions do *not* result in spoilt cores. Ask for full details from:

THE FORDATH ENGINEERING CO. LTD., HAMBLET WORKS, WEST BROMWICH, STAFFS.

TELEPHONE: *West Bromwich 0549, 0540, 1692* TELEGRAMS: *Metallical, West Bromwich*

# Some customers have one others have rows of them

No FOUNDRY is so small—if it is a commercial enterprise—that it can get along without a FORDATH 'New Type' Mixing Machine, one of the smaller sizes perhaps. And there is not a foundry so large that could not do *all* its sand mixing on a battery of FORDATH 'New Type' Mixers, choosing the sizes which suit it best.

The point is, and this is the thing to remember, the Fordath 'New Type' Mixer, in seven sizes with capacities from 20 lb. to 1 ton, mixes foundry silica sands with core binders without crushing. In two to three minutes it mixes and discharges a well aerated, homogeneous mixture—even with stiff compounds as low as 1%. All gears and bearings are totally enclosed and the drive is by V-belts from an electric motor.

These machines are in satisfactory operation, day in day out, in foundries large and small throughout the land and in many foreign lands.

*Interior of mixing chamber showing rotating blade and curved ribs which together rub and tumble the sand/binder into a perfect amalgam without crushing the sand grains.*

*Please write for full information*

## FORDATH 'NEW TYPE' MIXING MACHINES

SOLE MAKERS

*seven sizes, 20 lb. to 1 ton capacity*

THE FORDATH ENGINEERING CO. LTD., *Hamblet Works, West Bromwich, Staffs.*

*Telephone: West Bromwich 0549, 0540, 1692* *Telegrams: Metallical, West Bromwich*

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Certain things, like eggs and bacon, have an obvious, established association. Others, such as resins and foundries, are perhaps less obvious but as well established. For some years now the use of Catalin industrial resins for core moulding has been cutting costs and speeding production in foundries.

But there are other uses for resins in foundries and we are continuously developing materials and techniques—the man from Catalin is a specialist who is only too happy to tell you all about them.

*See the man from Catalin when he calls*

THE INDUSTRIAL RESIN DIVISION OF CATALIN LTD., WALTHAM ABBEY · Waltham Cross 3344

# DUSGARD now a proved success...

## ..for protection in the DANGER ZONE

**sterday—a novelty. Today—tested and proved.**

**rtmouth Auto Castings Ltd. handle more than 550 tons of castings r week in the dressing shop shown above. Here DUSGARDS have en working efficiently for more than a year. Already twelve are use, and others are in course of installation.**

**nefit from the experience of Dartmouth Auto Castings and other ding foundries, and fit the DUSGARD to *your* stand grinders.**

*We welcome enquiries from all parts of the world.*

**e DUSGARD is manufactured *exclusively* by**

**Air Control Installations Limited**

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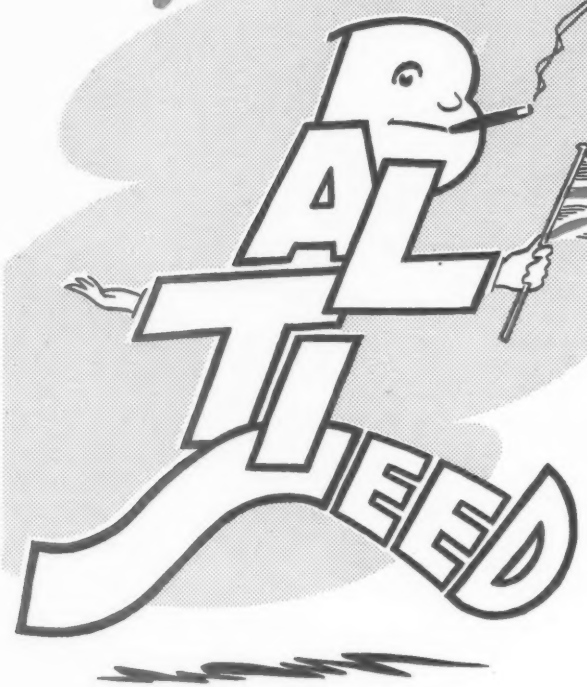


**SANDY BALTISEED**

presents the most comprehensive range of Core Binders ever offered to the Foundry Trade.

Whenever a new core-making problem presents itself, write or 'phone the address belów and our area representative, himself a core-making specialist, will quickly call upon you.

"Baltiseed"

CORE BINDERS

Wm. ASKE & Co. LTD

VICTORIA WORKS · WATERSIDE · HALIFAX

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Synthetic RESINS FOR THE FOUNDRY

Devised by FOUNDRYMEN for FOUNDRYMEN and made by

"Phenoform"

FOUNDRY RESINS LTD.

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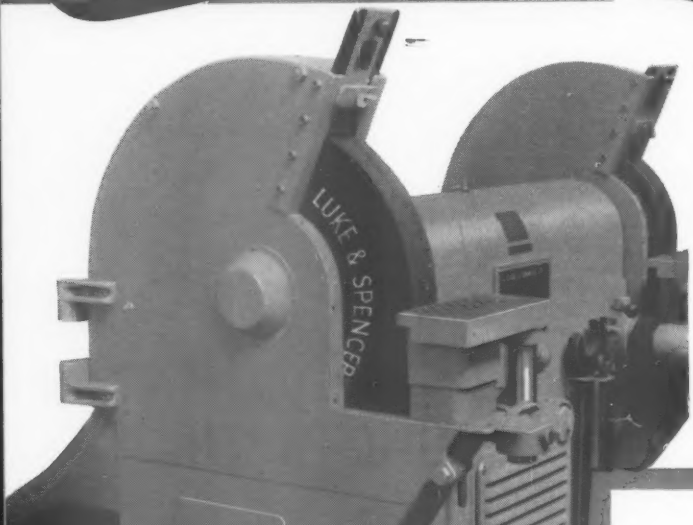
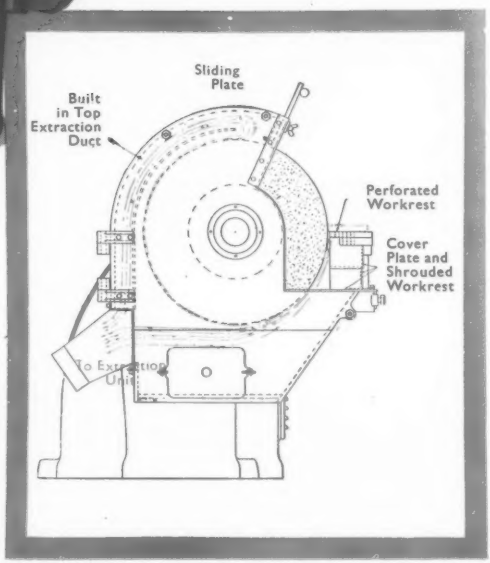
# dust control



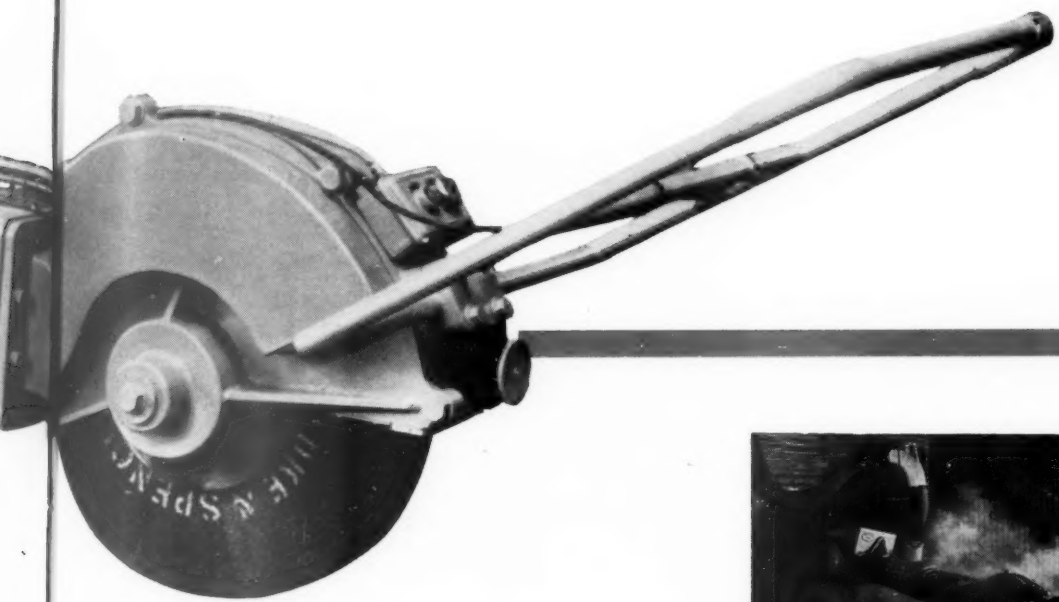

Luke & Spencer's latest models embody improvements which represent an important advance towa ds 100 per cent. dust extraction and can be relied upon to pass the strictest tests under present day regulations.




ıe Duplex (above) embodies these features:-

- Independent 3- speed drive to each wheel
- Quick-speed change mechanism
- Compulsory speeding-up of grinding wheels at correct diameters to maintain wheel cutting efficiency
- Safety mechanism to safeguard wheels against overspeed
- Available in four sizes with wheels 20, 24, 30 & 36 in. diameter . . . and it PROTECTS YOUR OPERATORS FROM DANGEROUS GRINDING DUST!

# GRINDERS



he ESC Swing Grinder is built around an entirely new theory f dust extraction. There is a main duct immediately in front f the wheel and a secondary side duct which draws the fine dust way from the top of the wheel at right angles to the line of otation.

XHAUSTIVE TESTS WHICH HAVE BEEN FILMED ROVE THAT THIS MACHINE COMPLETELY SOLVES NE OF THE WORST PROBLEMS IN THE CAMPAIGN GAINST PNEUMOCONIOSIS.

n your own and your operators' interests, write to us for full etails.

*Photographs show smoke produced by grinding wood (for demostration purposes) with extraction switched off (above) and with extraction switched on (below)*

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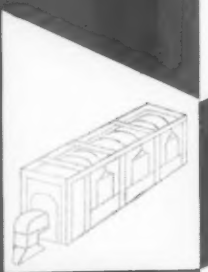

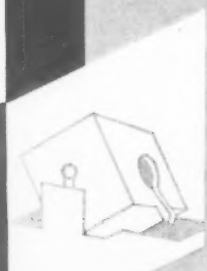

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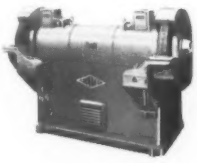
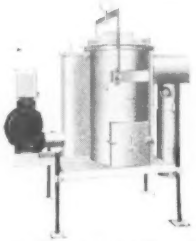
*International Congress of Foundrymen*



New Hilltop Grinder



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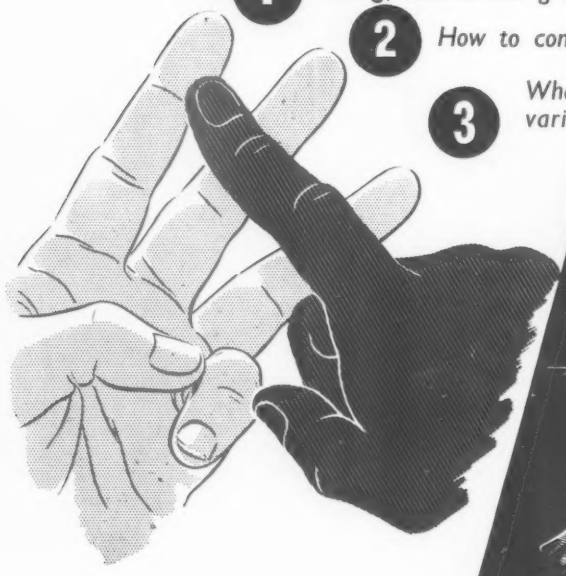

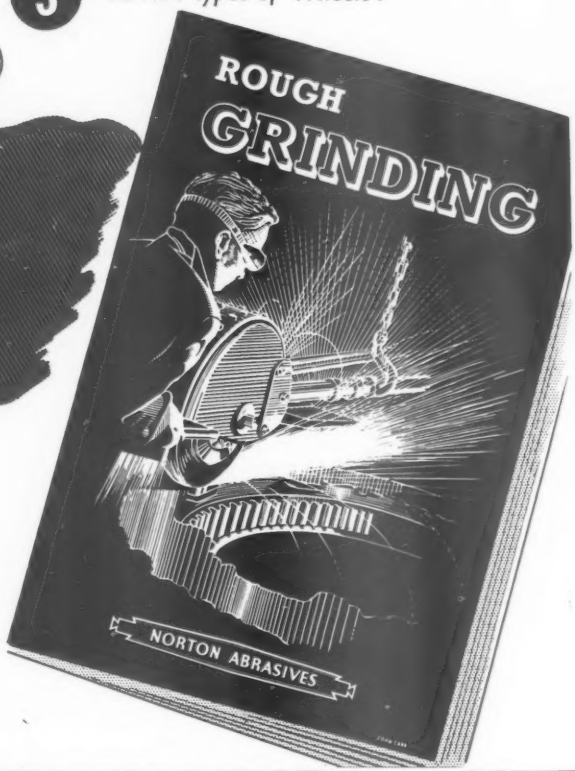


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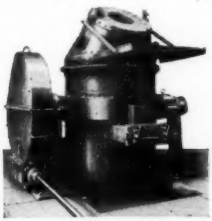
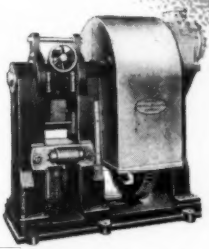


STEEL CONVERTER



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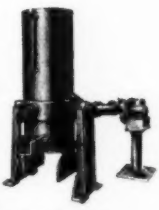

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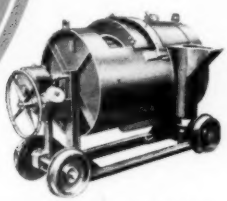
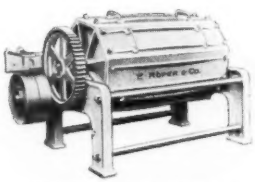


HOT METAL RECEIVERS



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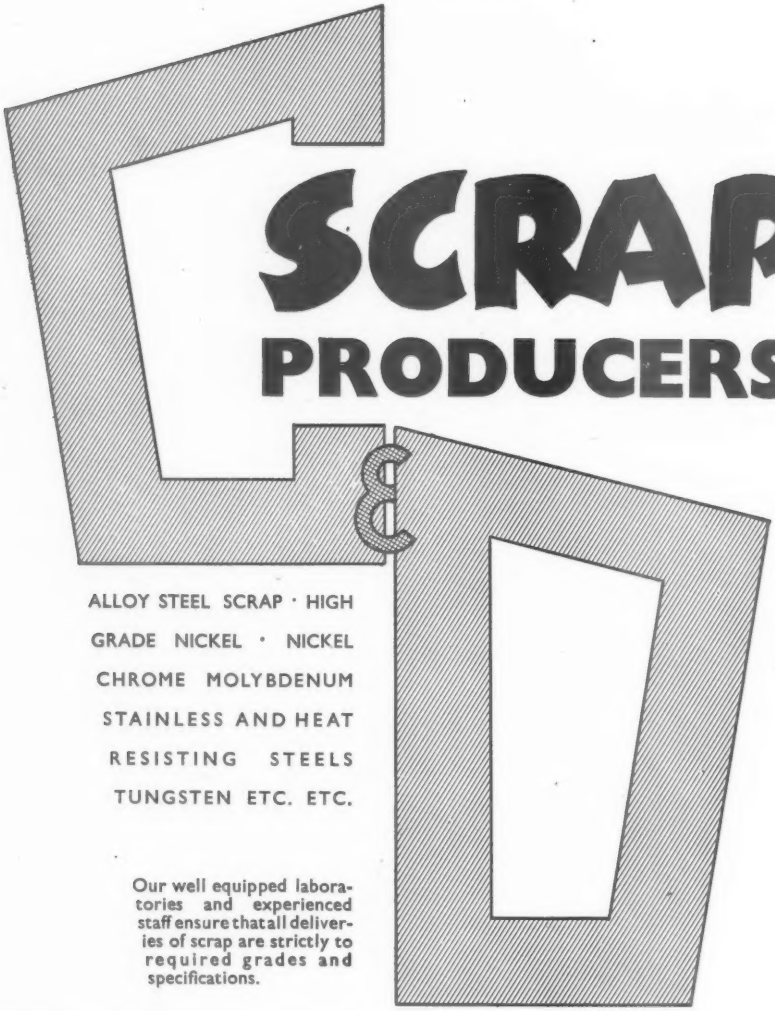


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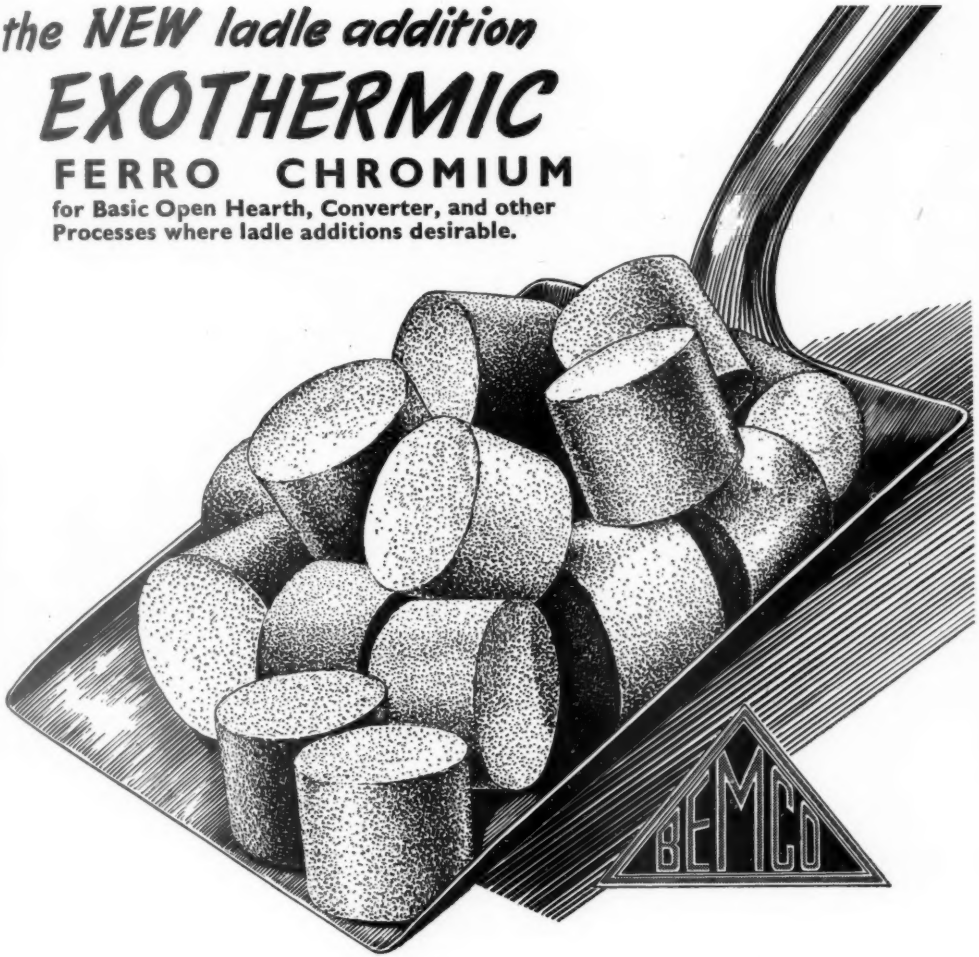


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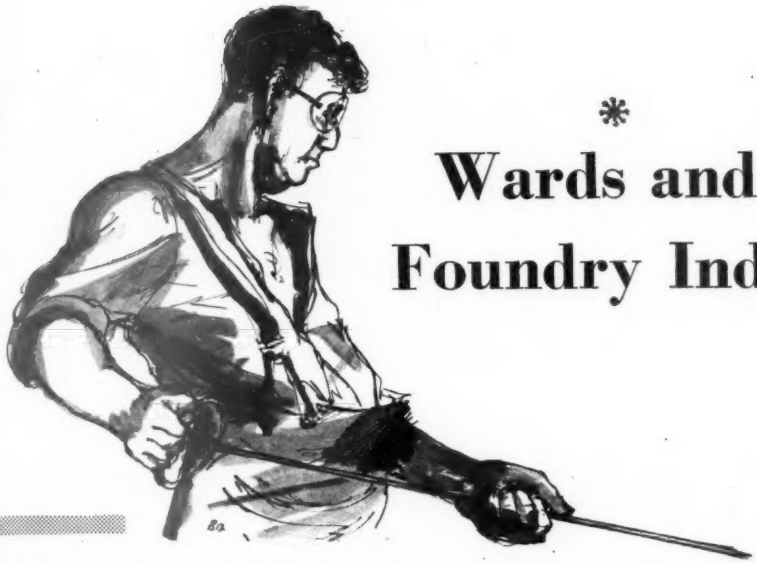

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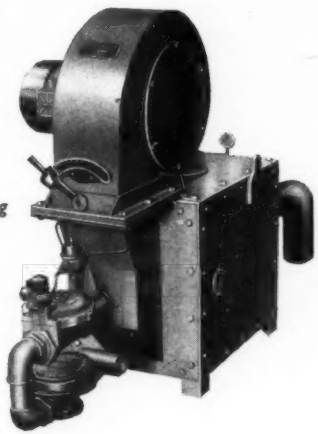

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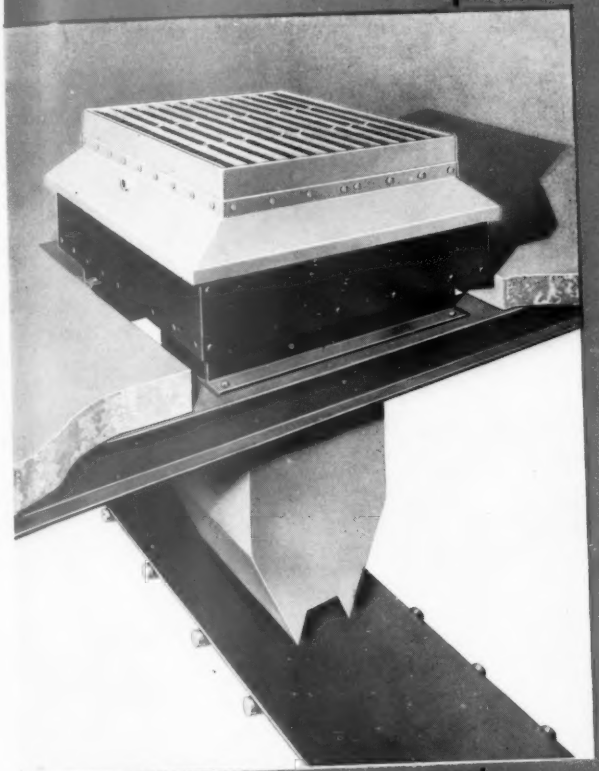

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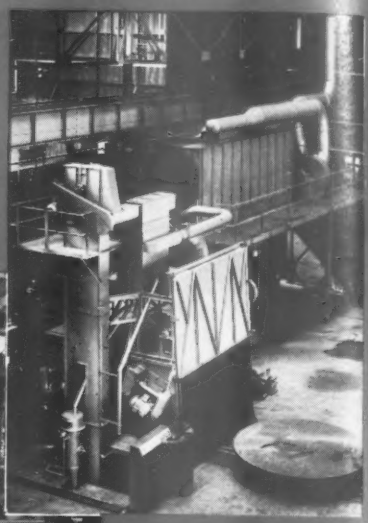
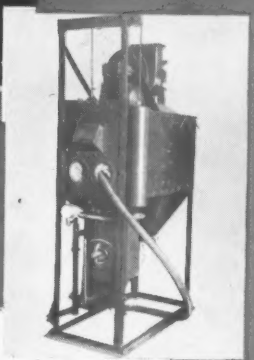
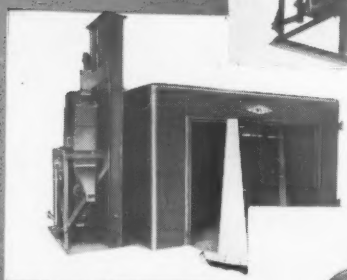


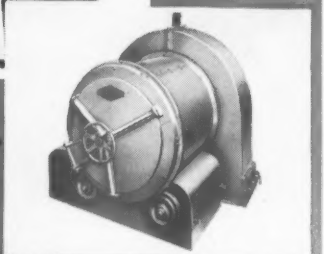
'AIRLESS' MULTI-TABLE.

COMPRESSED AIR CABINET.





COMPRESSED AIR ROOM WITH REVOLVING TABLE.



'AIRLESS' ROTARY BARREL.

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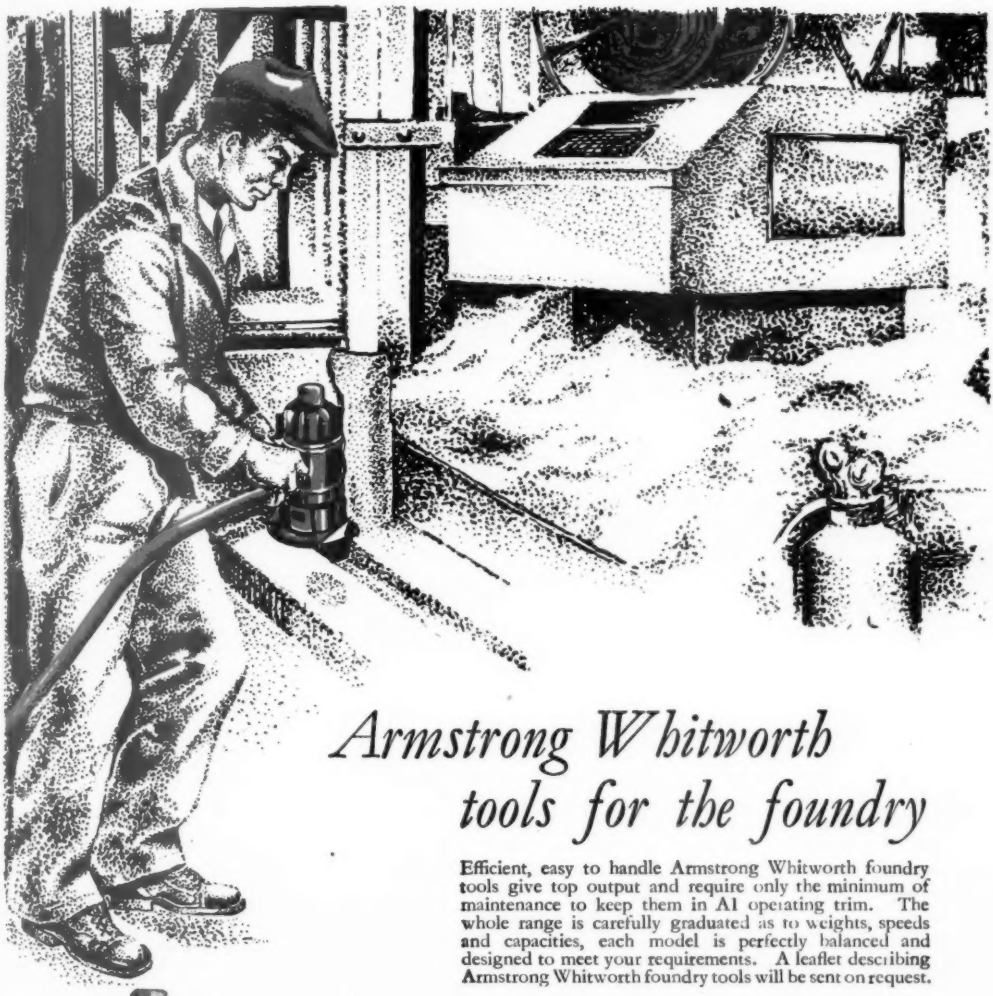

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Efficient, easy to handle Armstrong Whitworth foundry tools give top output and require only the minimum of maintenance to keep them in A1 operating trim. The whole range is carefully graduated as to weights, speeds and capacities, each model is perfectly balanced and designed to meet your requirements. A leaflet describing Armstrong Whitworth foundry tools will be sent on request.

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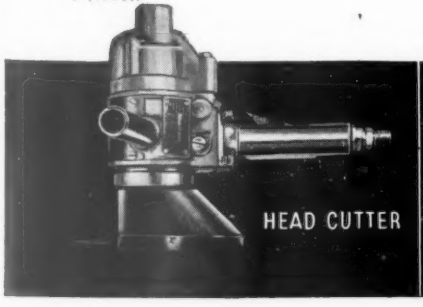


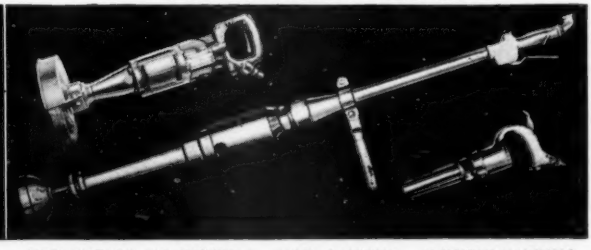

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*What are you doing to assist him in producing a good mould?*

SAND TESTING ENABLES THE FOUNDRYMAN TO ASSESS AND CONTROL THE PHYSICAL PROPERTIES OF MOULDING MATERIALS AND GIVES HIM ADVANCED ASSURANCE THAT THE SANDS HE USES WILL SERVE THEIR PURPOSE.

*Photograph by courtesy of Ashmore, Benson, Pease & Company.*

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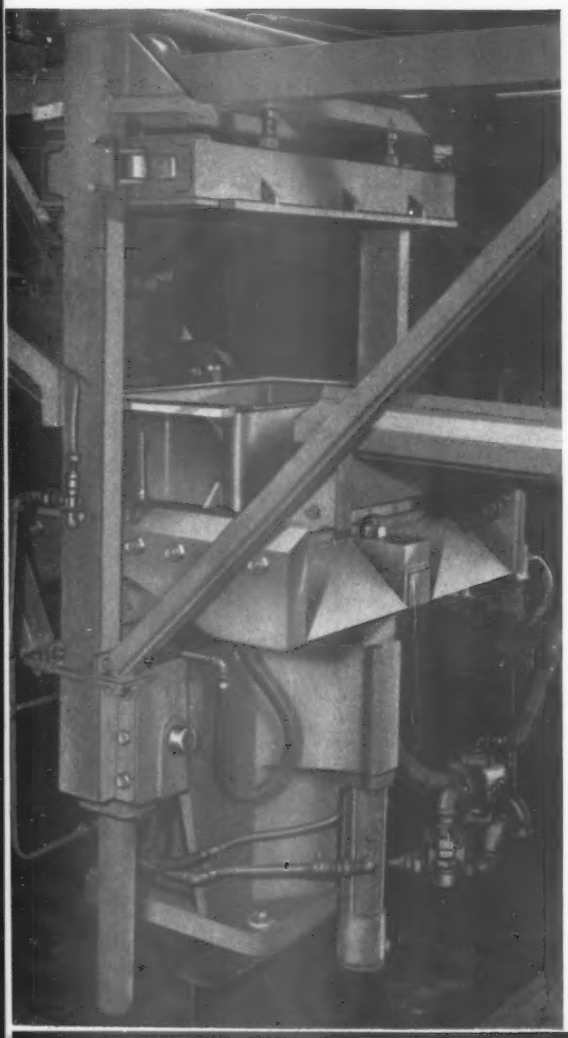
# ELIMINATE MOULDING LABOUR with the MOLDMATIC



1 Start the machine and it carries on produ moulds until it is stopped.

2 This machine can produce 240 copes or drag hour.

3 Box size 34in. by 20in. by 10in.

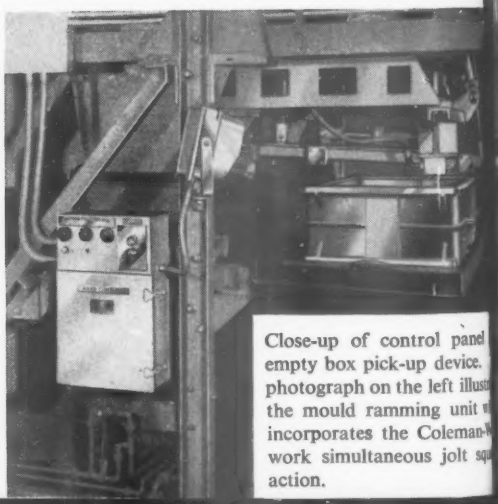
4 Incorporates automatic sand and weigh hoppe

5 Flexible in operation, variable time cycle to particular job.

6 Quick pattern change.

7 These machines are now installed at the Li Works of Ley's Malleable Castings Co. Ltd.

*World Patents applied for.*



Close-up of control panel empty box pick-up device. photograph on the left illust the mould ramming unit w incorporates the Coleman-W work simultaneous jolt squ action.

**THE COLEMAN-WALLWORK COMPANY LT**

32 VICTORIA STREET LONDON S.W

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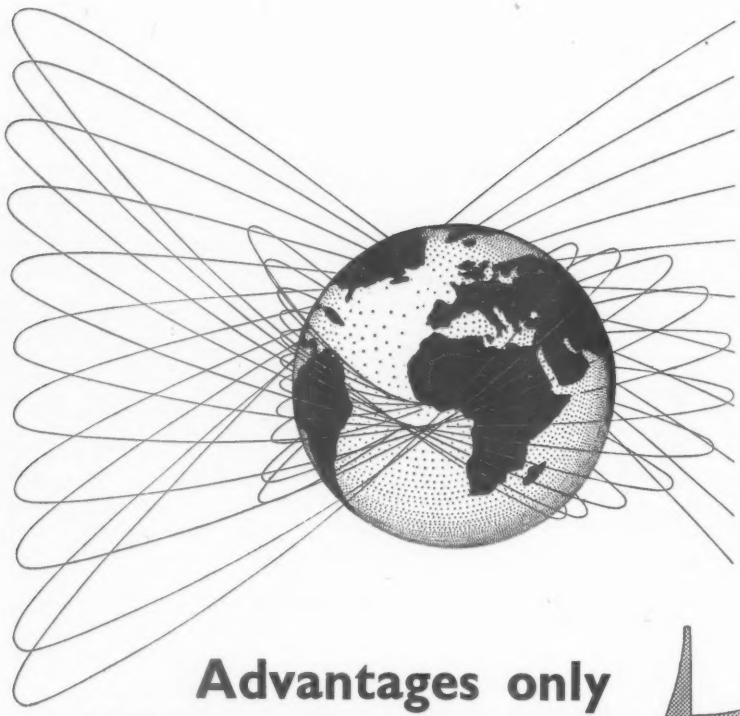

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# Advantages only A MEEHANITE FOUNDRY can offer . . .

All Meehanite Licensee Foundries are members of a world-wide organisation. Through the Meehanite Research Institute they share a constant exchange of information on every phase of foundry practice, based on continuous research and practical experience.

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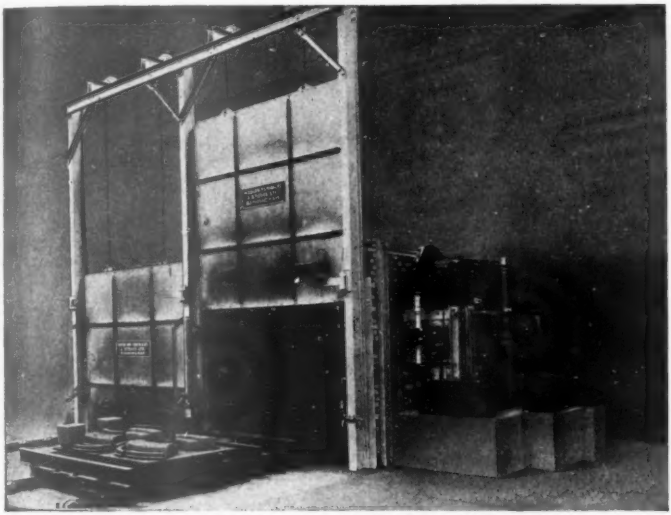
*Conforms to all the requirements of the "IRON & STEEL FOUNDRIES REGULATIONS (1953)"*



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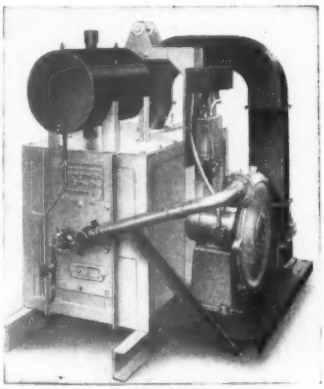
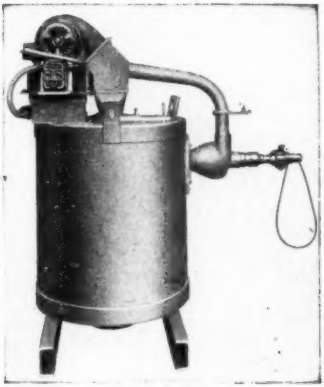


OIL FIRED



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**BUILT TO WITHSTAND ROUGH HANDLING**

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SPECIAL ARRANGEMENTS TO SUIT INDIVIDUAL REQUIREMENTS.

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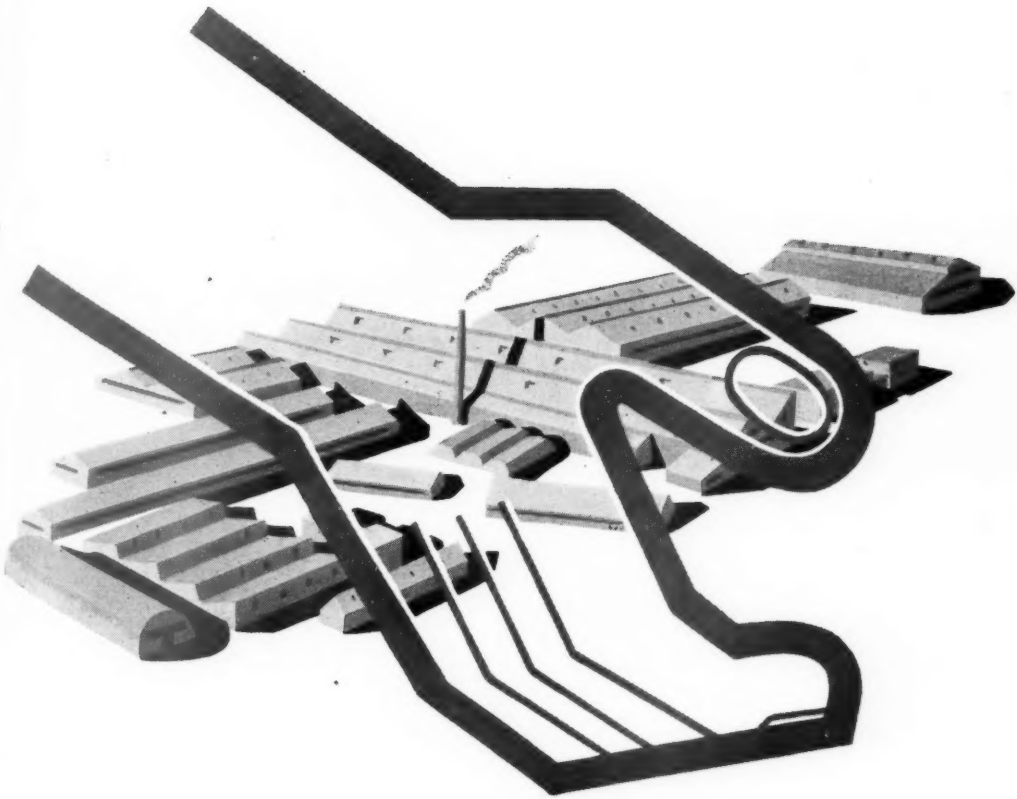

*look forward to meeting members of the*

*International Foundry Congress*

*at James Bridge Steel Works on June 27*

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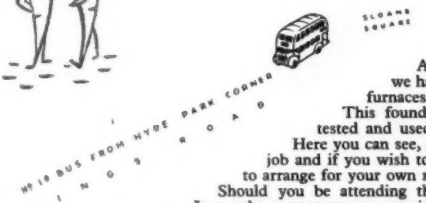
# While in London

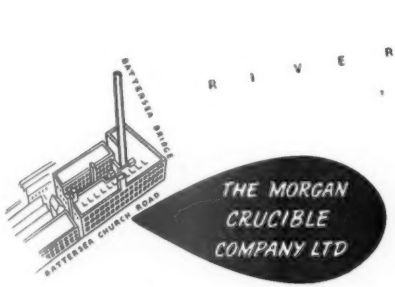
**INTERNATIONAL FOUNDRY CONGRESS**
**Dorchester Hotel, Park Lane, W.1.**
**JUNE 20-26 1955**

A Battersea, juste de l'autre côté du fleuve et d'accès facile, nous avons une fonderie où une série complète de fours à creuset Morgan peut être examinée sous conditions normales de travail.
Cette fonderie n'est pas une salle d'exposition ; ici les fours sont non seulement mis à l'essai mais sont employés également pour la production faisant usage de divers genres de combustible. Ici vous pouvez voir, examiner et choisir le four pour votre travail particulier et si vous désirez faire une preuve finale quant à sa convenance nous serions heureux de nous arranger pour que votre propre métal puisse être utilisé lors de votre visite.
Si vous avez l'intention de participer au Congrès International de la Fonderie au mois de juin, pourquoi ne pas accepter notre invitation de vous rendre à Battersea? Pouvons nous compter sur votre visite?
Ecrivez ou téléphonez au Département Creusets pour fixer un rendez-vous.

In Battersea, nur über den Fluss hinaus, und leicht zugänglich, haben wir eine Giesserei, wo eine vollständige Reihe von unseren Tiegelöfen unter Arbeitsverhältnissen besichtigt werden kann.
Diese Giesserei ist nicht nur ein Ausstellungsraum ; hier werden die Öfen Versüchen unterworfen, sowie für Herstellungszwecke verwendet, wobei verschiedene Brennstoffe gebraucht werden. Hier können Sie gerade den Öfen besichtigen, untersuchen und erwählen, der Ihrer besonderen Arbeit entspricht ; und wenn Sie einen Endversuch betreffs seiner Geeignetheit ausführen wollen, so sind Sie willkommen Vorkehrungen zu treffen, dass Ihr eigenes Metall beim Besuch verwendet wird.
Falls Sie sich an dem Internationalen Giesserei-Kongress in London, in Juni, beteiligen, warum denn nicht unsere offene Einladung akzeptieren und Battersea besuchen?
Kommen Sie?
Schreiben Sie uns, oder rufen Sie unsere Tiegelabteilung (Crucible Dept.) zwecks Verabredung an.




At Battersea, just over the river, and easy of access, we have a foundry where a complete range of our crucible furnaces may be seen under working conditions.
This foundry is not just a Showroom ; here furnaces are both tested and used for production purposes, using a variety of fuels.
Here you can see, examine, and choose, the furnace for your particular job and if you wish to make a final test of its suitability you are welcome to arrange for your own metal to be used when visiting.
Should you be attending the International Foundry Congress in London, in June, why not accept our open invitation to call at Battersea?
Will you come?
Write, or ring our Crucible Department and make an appointment.

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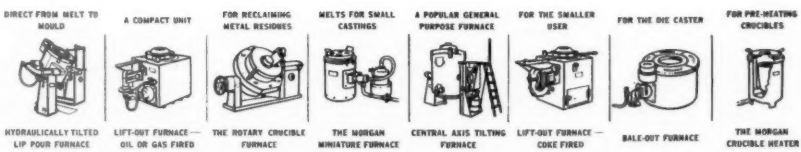
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*... seasoned in foundry service*

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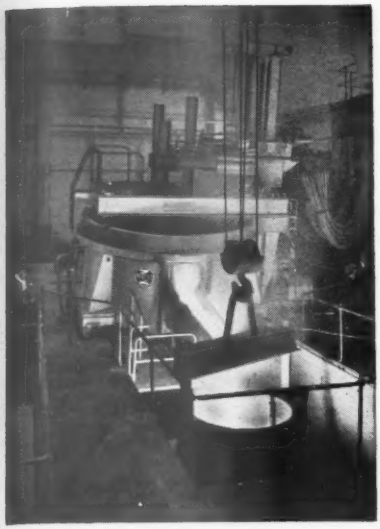

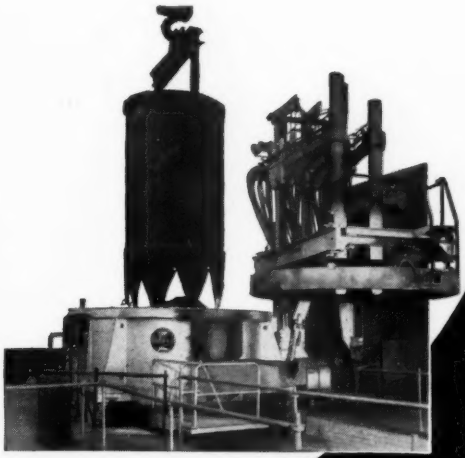

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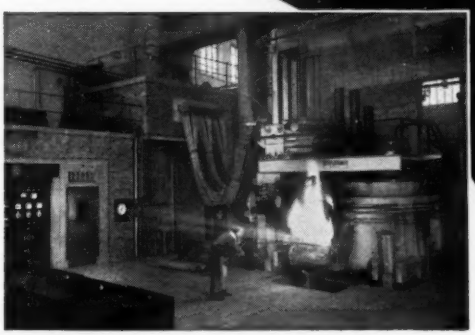
*The illustrations show three views of Messrs. Tennent's new furnace.*



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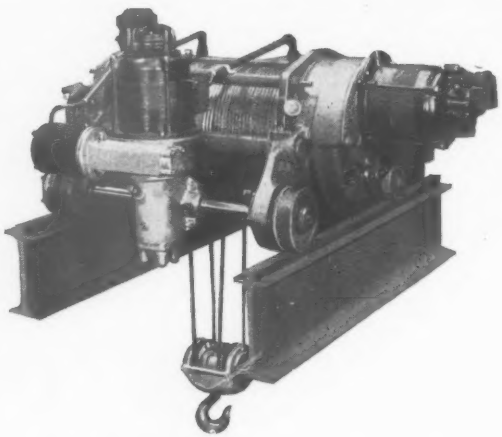
# PIG IRON

STAVELEY

The range of Staveley pig irons offers material for all general foundry purposes.

The Staveley Technical service is offered free to any requiring advice on foundry problems.

THE STAVELEY IRON & CHEMICAL CO. LTD. NR. CHESTERFIELD



2-ton, 4-motor crab with creeping speed all motions.

# take it easy

*when core-drawing and handling boxes in the foundry.*

MATTERSON Creeping Speed Equipment gives precise control.

**Crab shown is size 423, 2 tons capacity, and has creeping speed on all motions, hoisting at 30 or 3 f.p.m. and travelling at 70 or 2 f.p.m.**

**All Blocks and Cranes in the range 5 cwts to 10 tons can be fitted with this invaluable 'go-slow' feature.**

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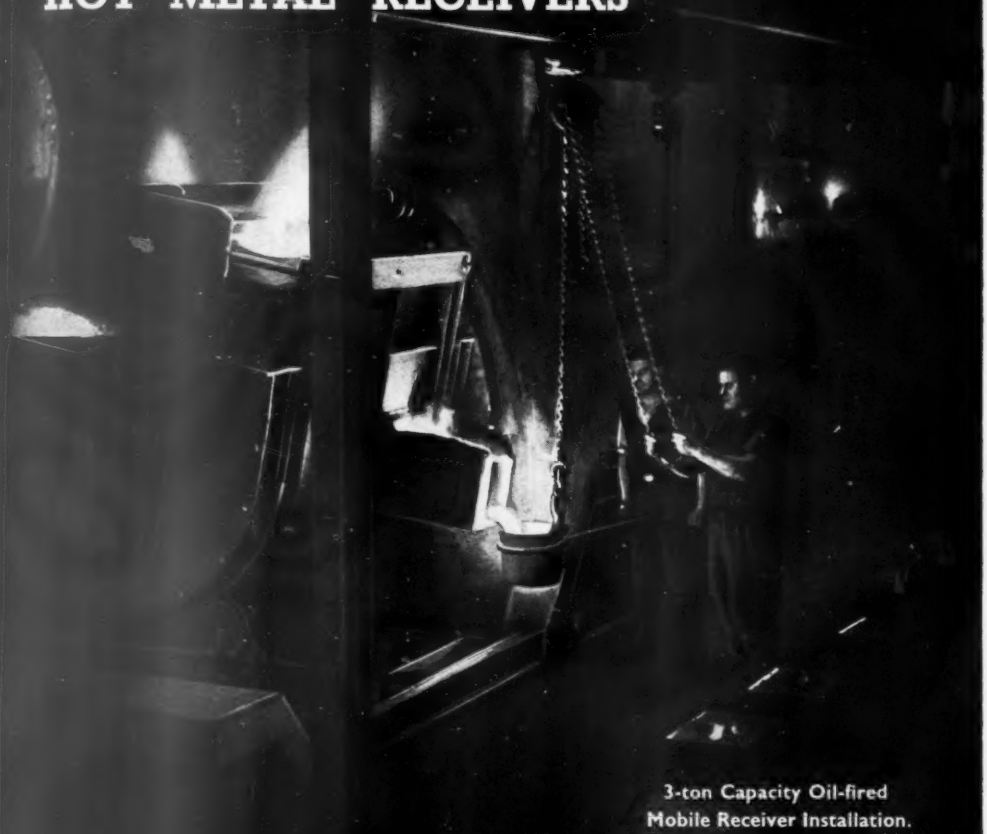

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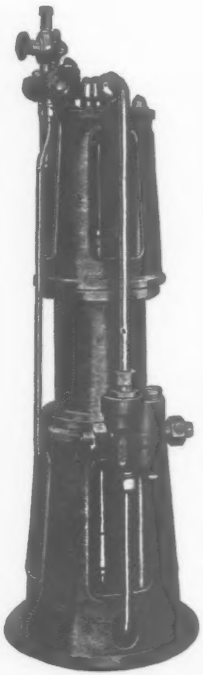

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Airhydropump being used for Pressure Testing.

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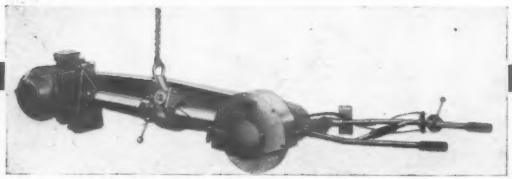

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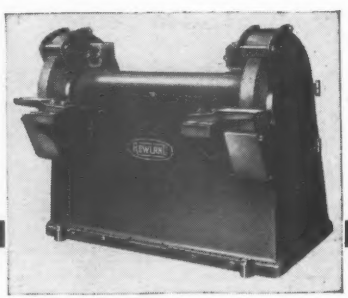

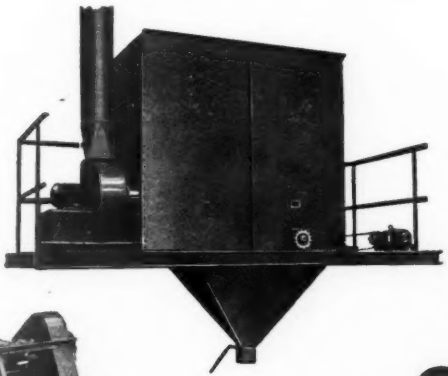

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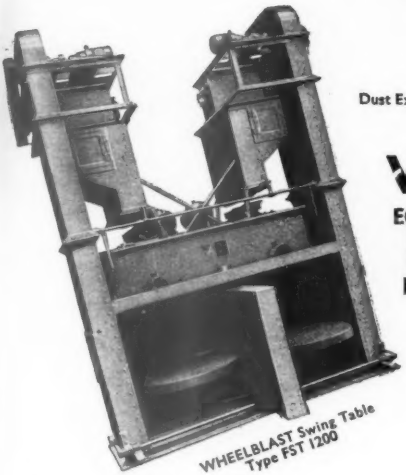

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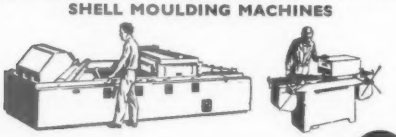

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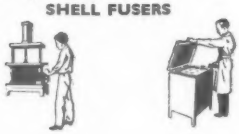

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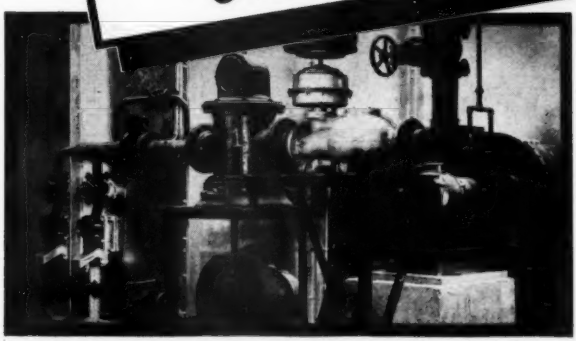

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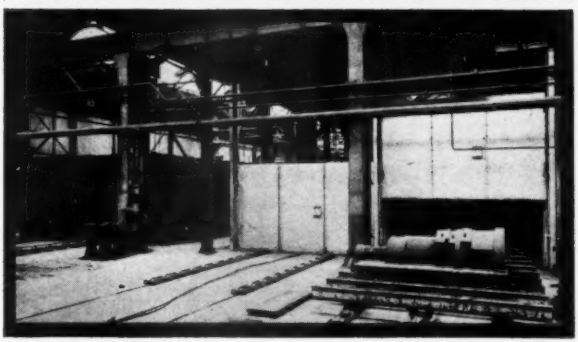

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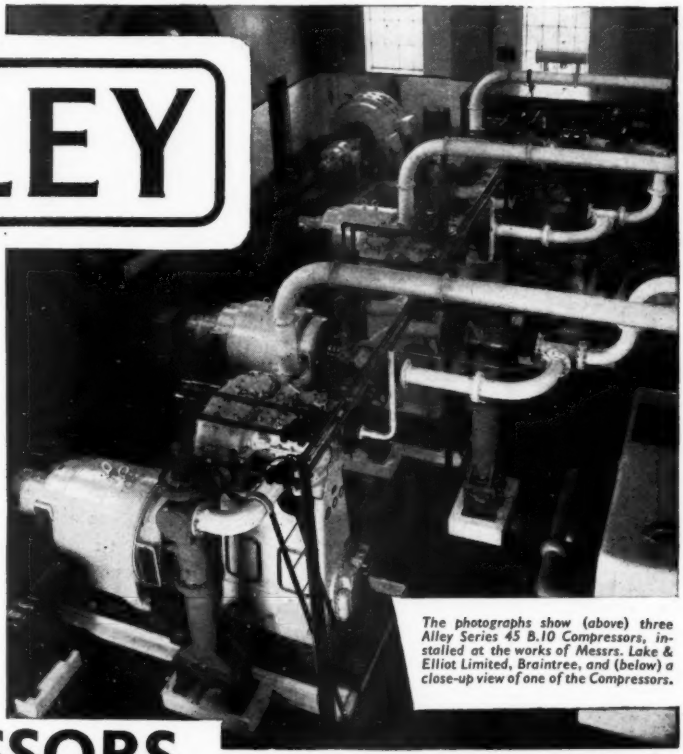

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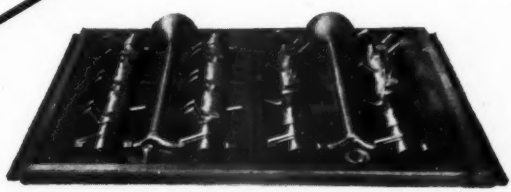

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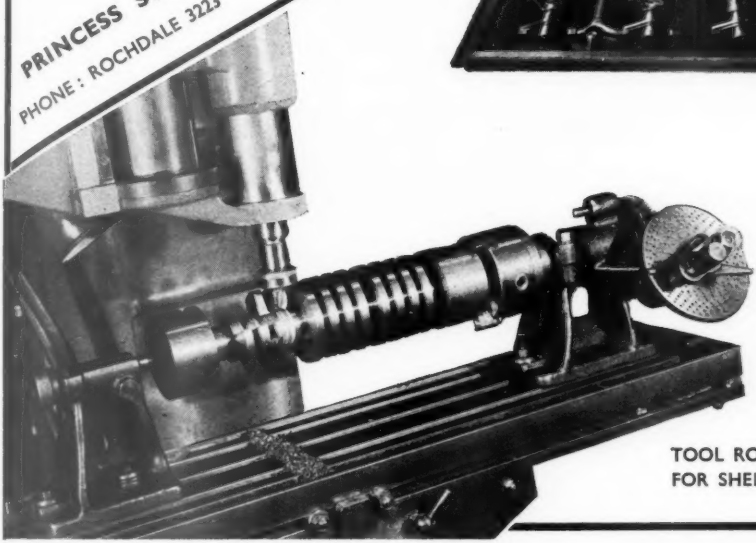

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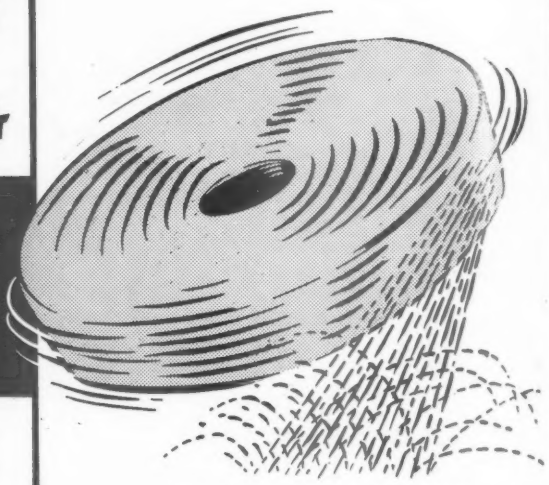

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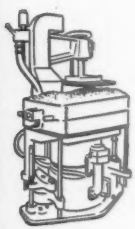

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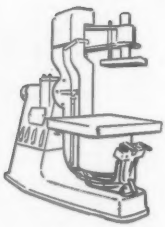

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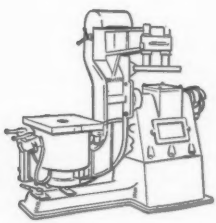

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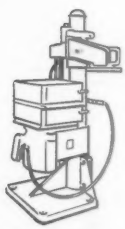

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